GROUND WATER INVESTIGATION
TRONOX NAVAJO AREA URANIUM MINES
SAN MATEO CREEK BASIN

Grants Mining District, NM

August 1, 2017

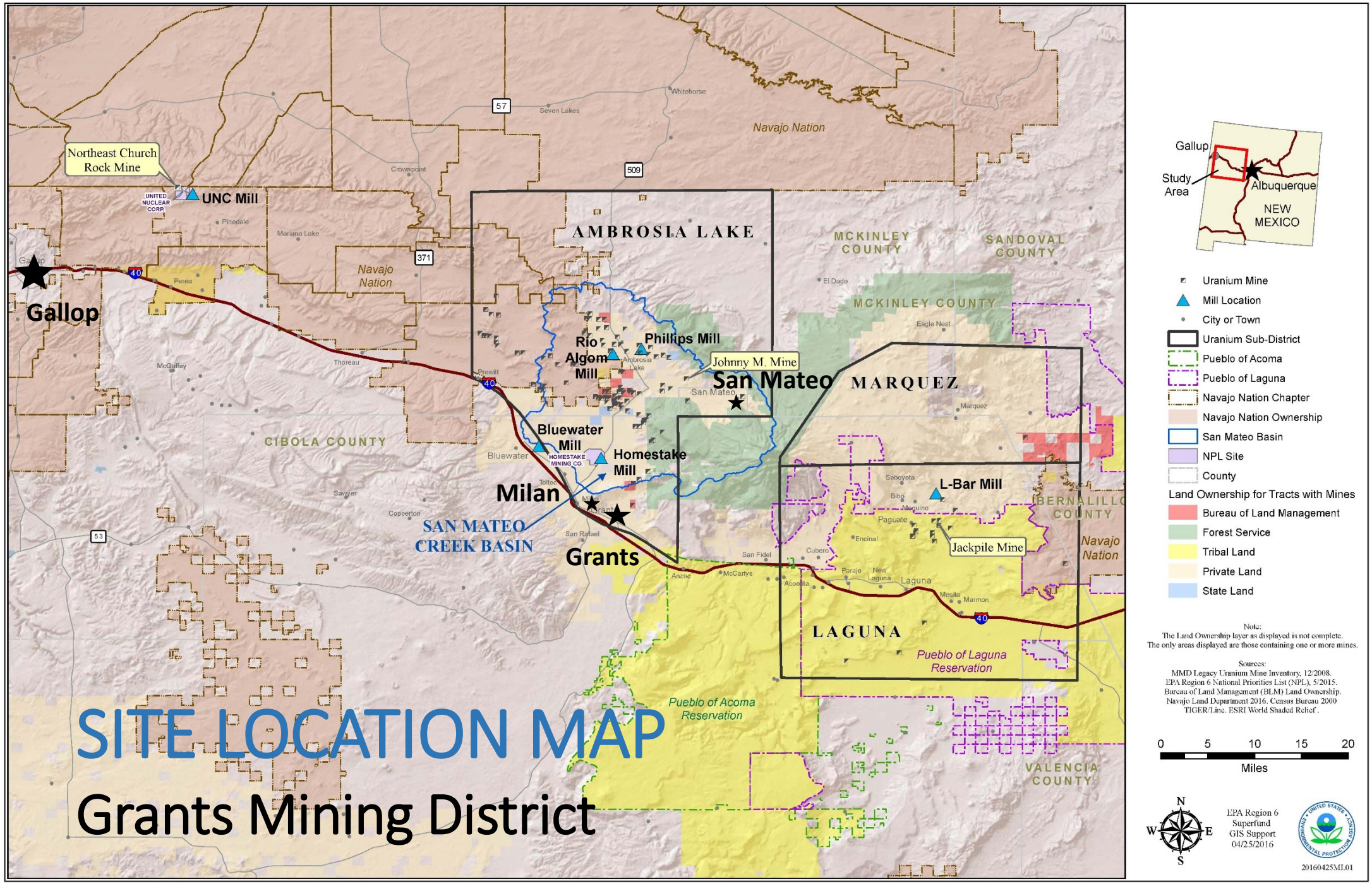
9881701

A GOAL OF EPA'S 2015 GRANTS MINING DISTRICT FIVE-YEAR PLAN

- ASSESS URANIUM INDUSTRY IMPACTS ON WATER SUPPLY SOURCES
  - Concern for Potential Widespread Degradation of Ground Water Quality
- BUILD CONCEPTUAL SITE MODEL BY 2018
  - Use as a Tool to Understand Impacts on Ground Water
- COLLABORATE WITH NM, DOE AND NRC
  - Share Information on Legacy Mines and Mills and Collect Ground Water Data

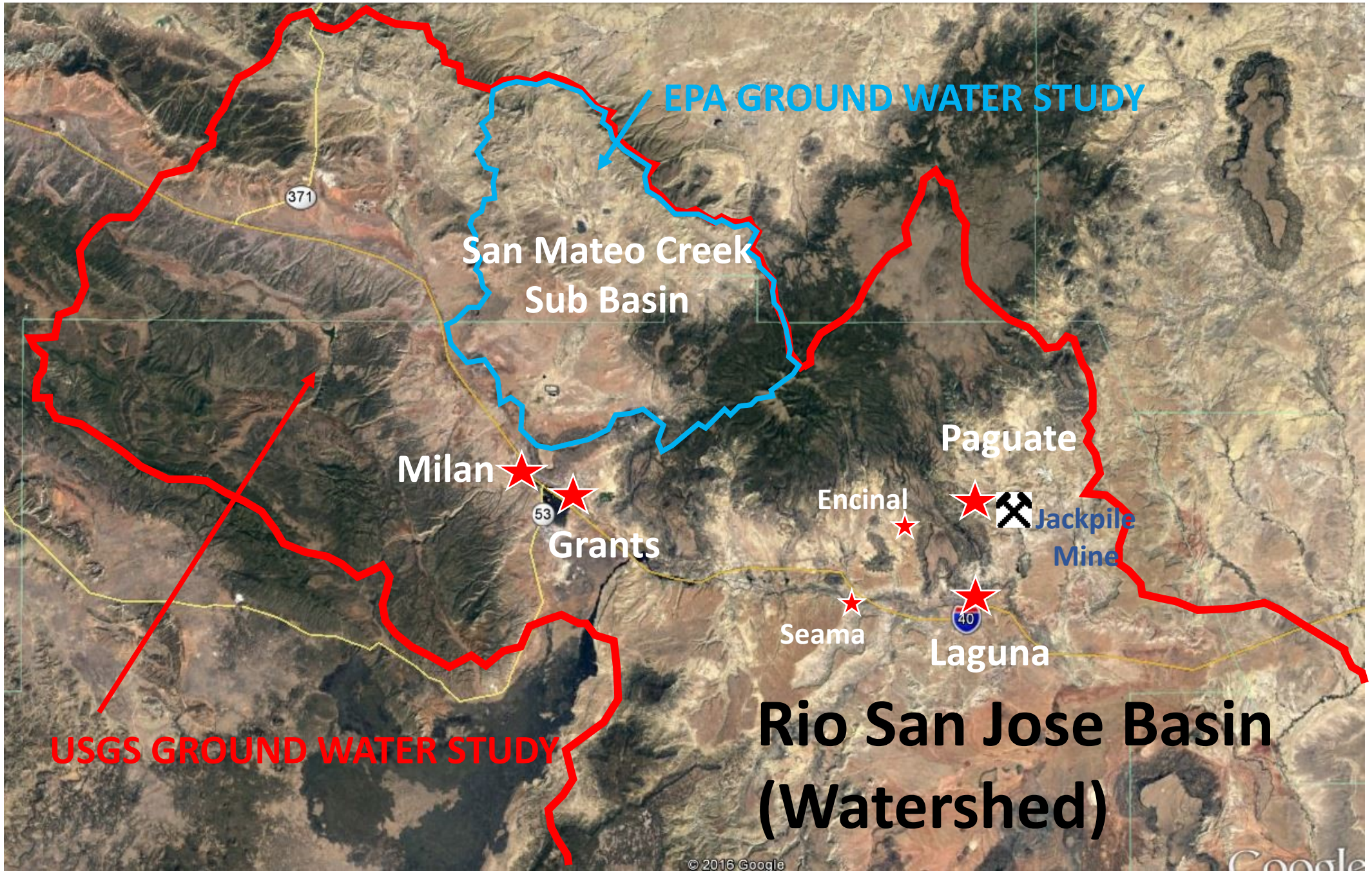
COORDINATION WITH KEY STAKEHOLDERS

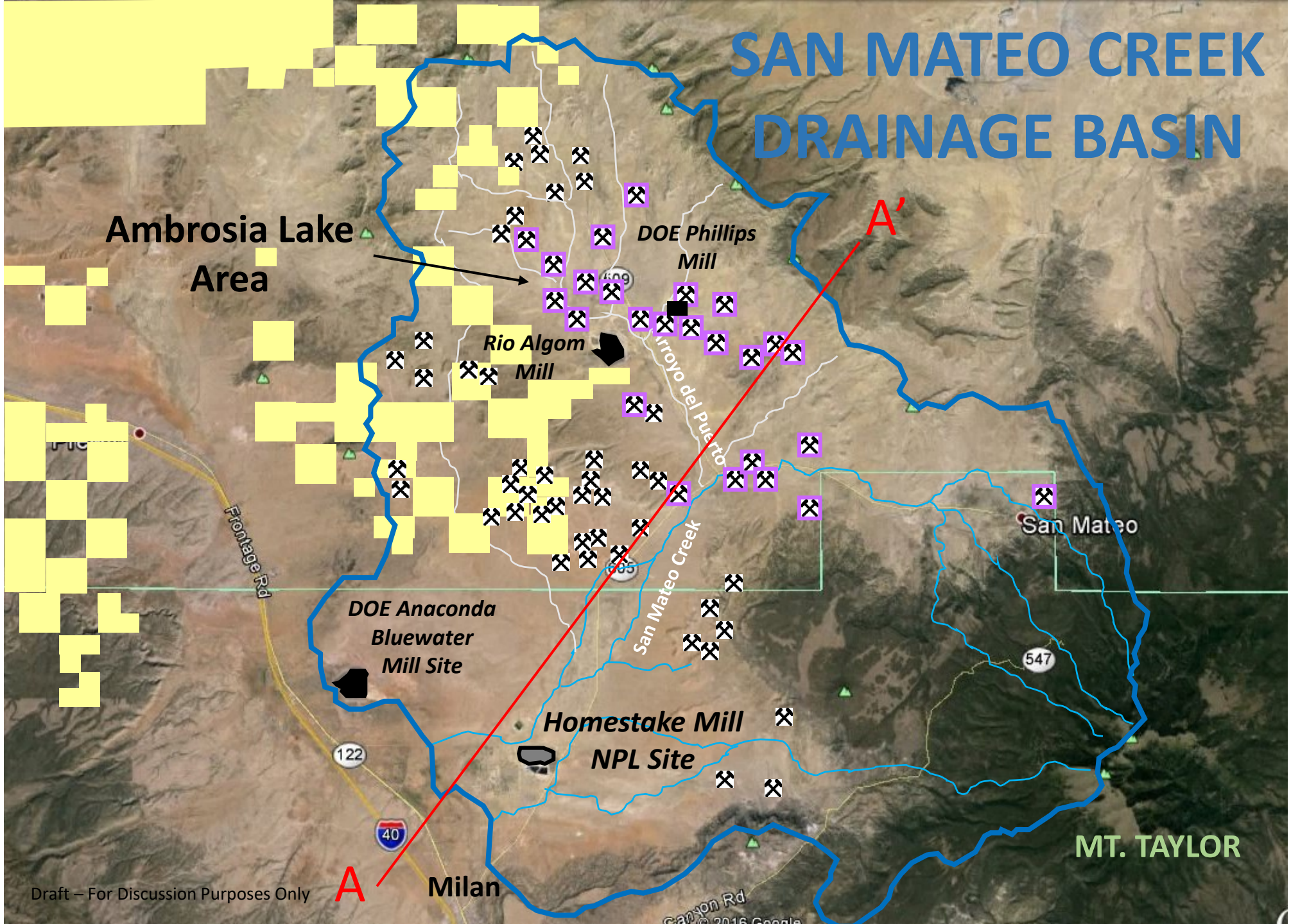
- COMMUNITY
- REGULATORY PARTNERS OF 5-YEAR PLAN
  - NM Environment and Energy, Minerals and Natural Resources Departments
  - NM Department of Health
  - USFS
  - DOE
  - NRC
  - DOI
  - ATSDR
  - Laguna Pueblo
- NAVAJO NATION AND REGION 9
  - Navajo Funded Portion of Study from Tronox Settlement
- ACOMA PUEBLO
- ENVIRONMENTAL GROUPS
  - Multi-cultural Alliance for Safe Environment
  - Bluewater Valley Downstream Alliance
- US GEOLOGICAL SURVEY



SITE LOCATION MAP

Grants Mining District


EPA GROUND WATER STUDY
San Mateo Creek
Sub Basin
371
Milan
53
Grants
Paguate
Encinal
Jackpile
Mine
Seama
40
Laguna
USGS GROUND WATER STUDY
Rio San Jose Basin
(Watershed)
© 2016 Google



LEGEND

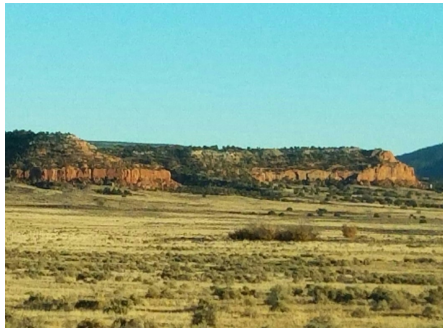
- Navajo Land
- Legacy Uranium Mine
- Uranium Wet Mine

321 Square Miles

81 Mines (Total)

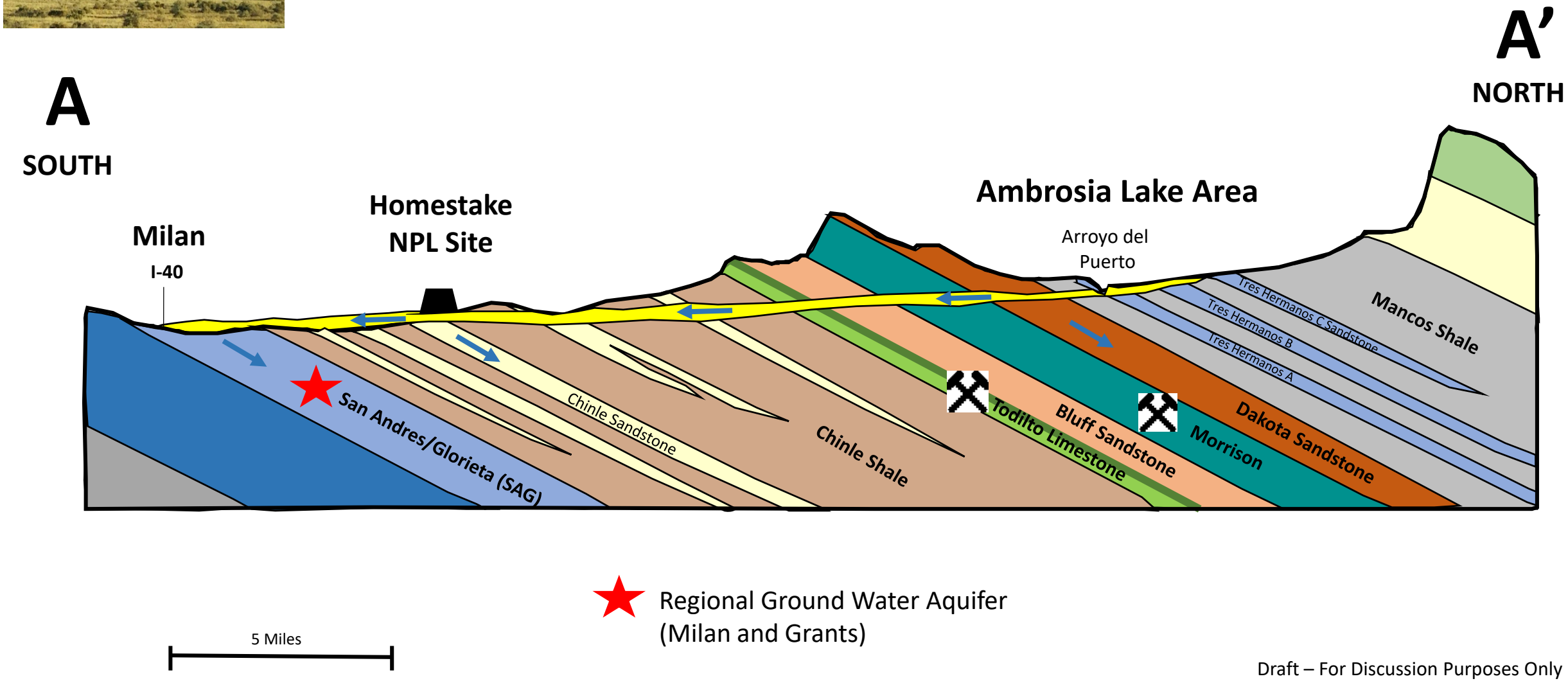
25 Wet Mines

4 Uranium Mills



CONCEPTUAL SITE GROUND WATER MODEL

Generalized Cross Section Through San Mateo Creek Basin



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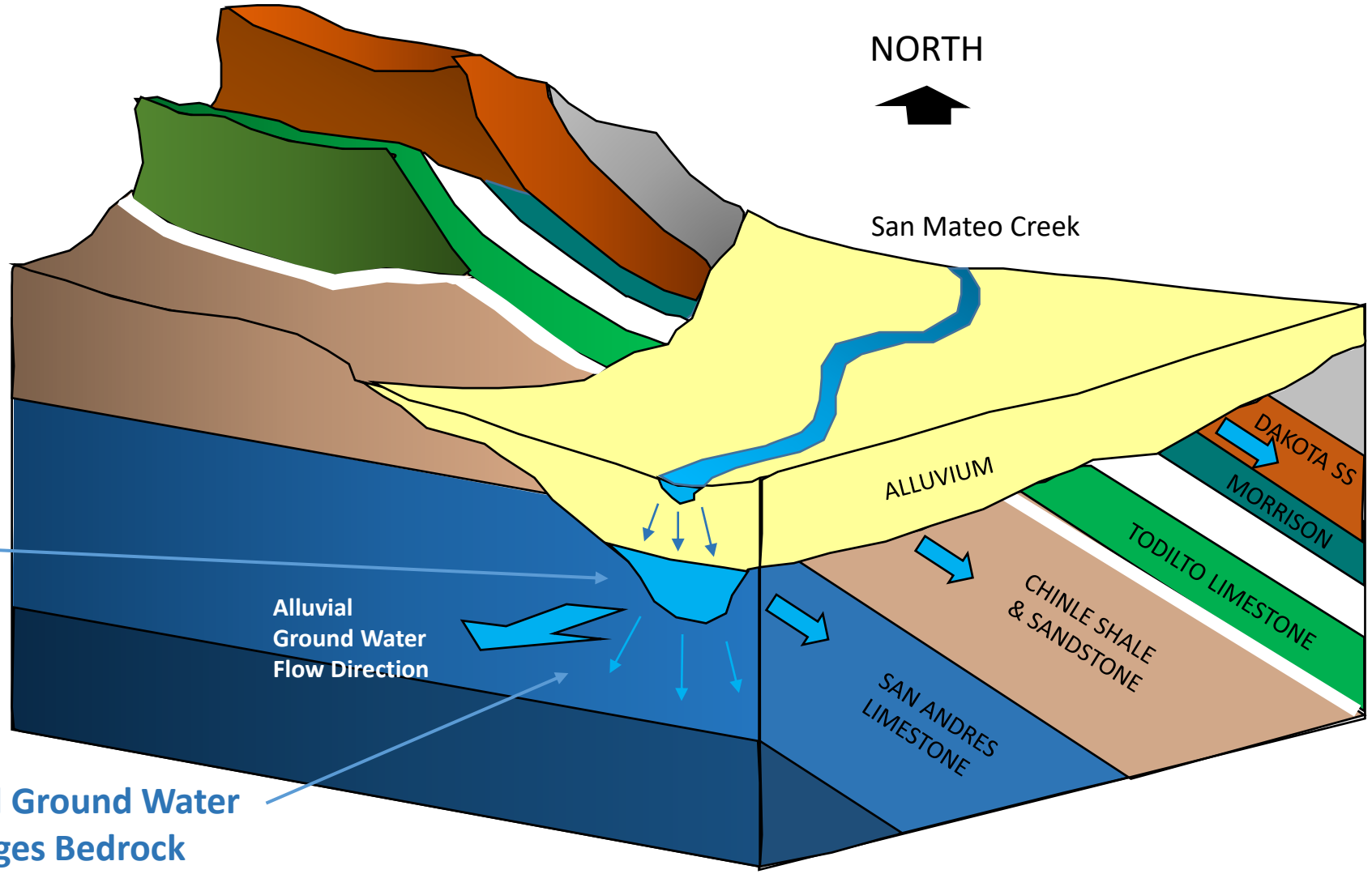
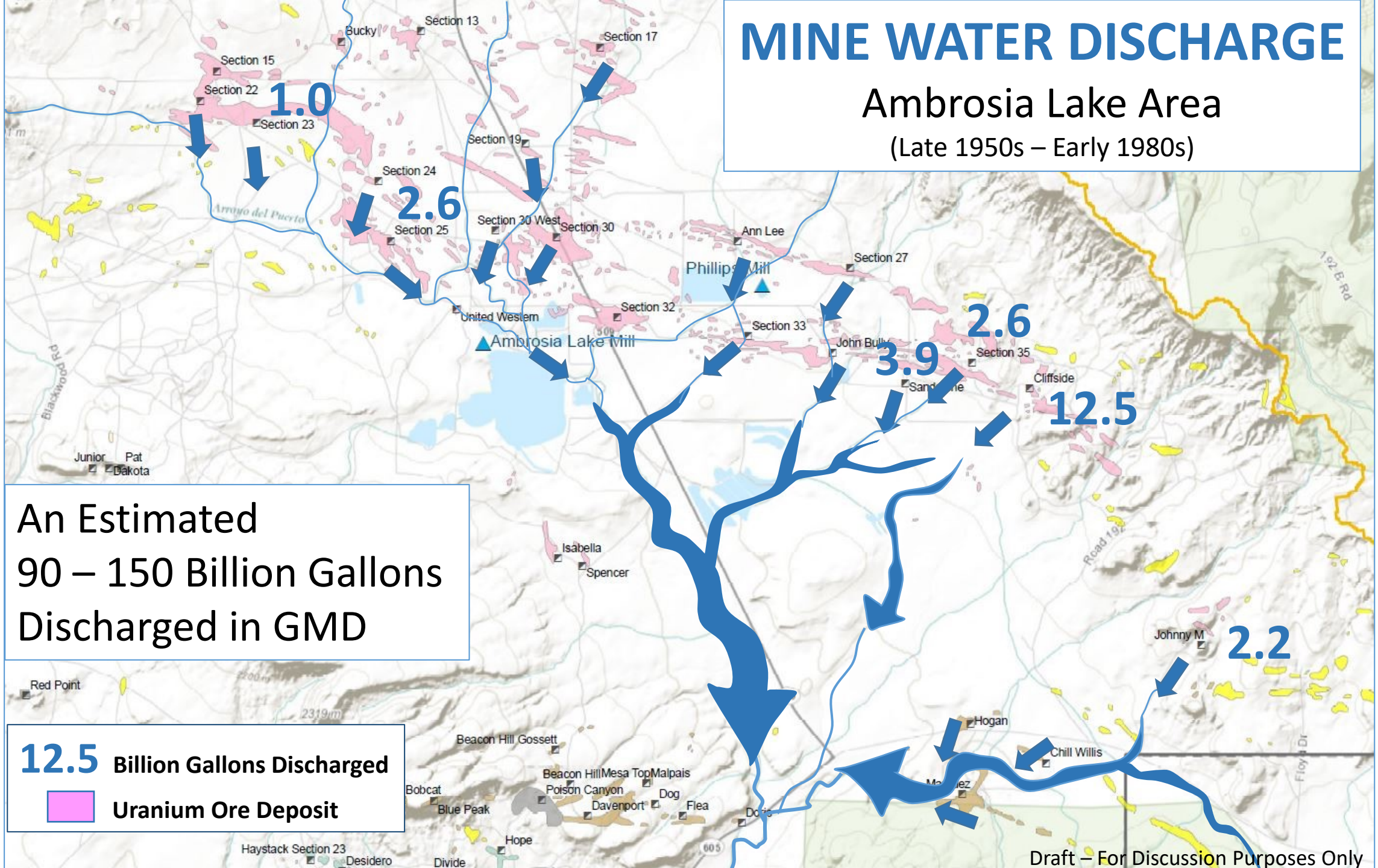
CONCEPTUAL SITE GROUND WATER MODEL



Surface Water Recharges Alluvium

Alluvial Ground Water Recharges Bedrock Aquifers


MINE WATER DISCHARGE
Ambrosia Lake Area
(Late 1950s – Early 1980s)
An Estimated
90 – 150 Billion Gallons
Discharged in GMD
12.5 Billion Gallons Discharged
Uranium Ore Deposit
1.0
2.6
2.6
3.9
12.5
2.2
Section 13
Section 17
Section 15
Section 22
Section 23
Section 19
Section 24
Section 25
Section 30 West
Section 30
Ann Lee
Section 27
Section 32
Section 33
Section 35
United Western
Ambrosia Lake Mill
Phillips Mill
John Bull
Cliffside
Junior
Pat
Dakota
Isabella
Spencer
Red Point
Beacon Hill Gossett
Beacon Hill
Mesa Top
Malpais
Poison Canyon
Dog
Davenport
Flea
Bobcat
Blue Peak
Hope
Haystack Section 23
Desidero
Divide
Johnny M
Hogan
Chill Willis
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WHAT ARE IMPACTS TO BASIN FROM DISCHARGE OF LARGE VOLUMES OF MINE WATER?

SURFACE WATER IMPACTS

Discharge Artificially Created Perennial Surface Flow

May have reached Homestake Impoundment (EPA 1980)

⚒ WET MINE

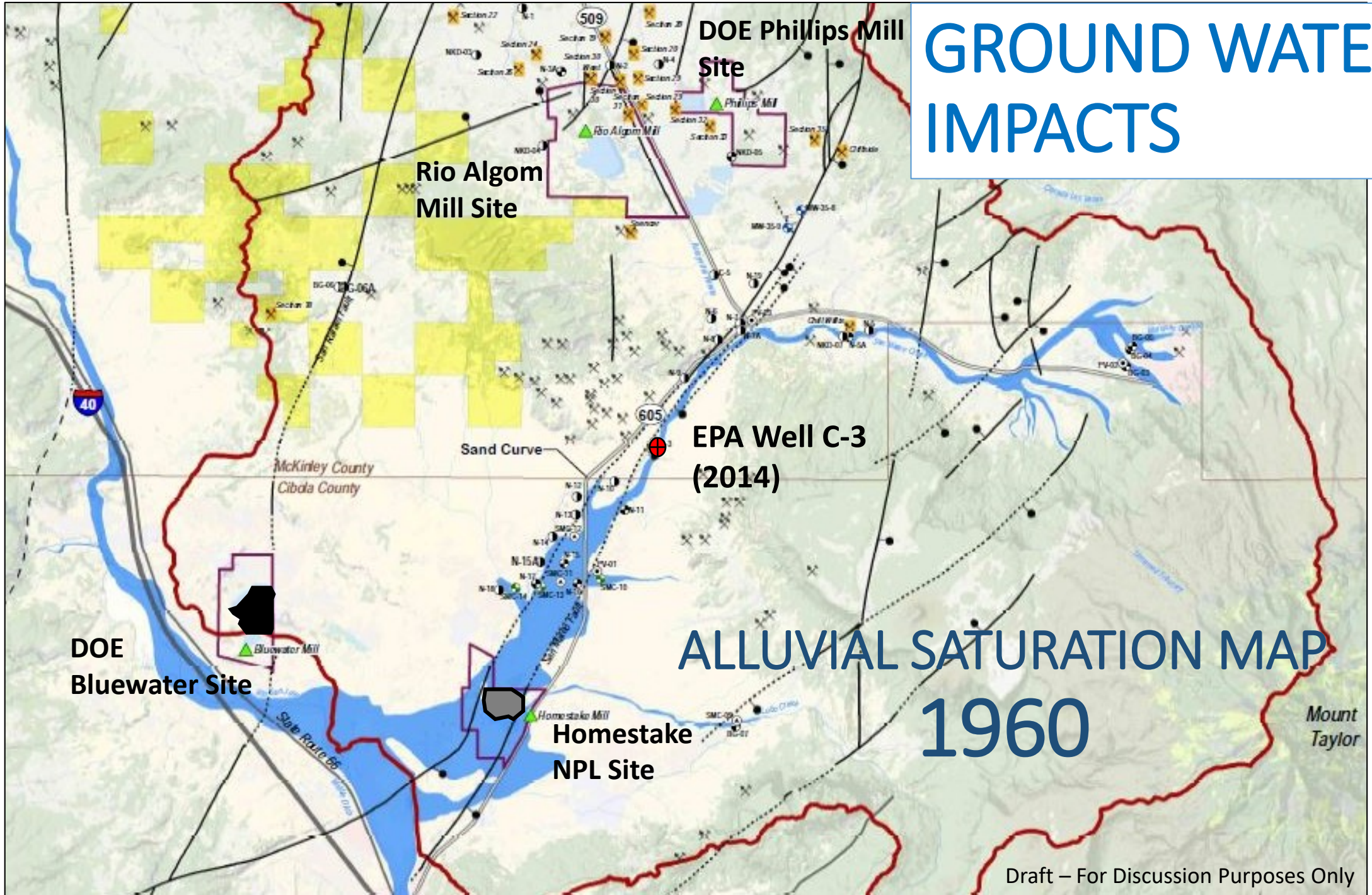
SUMMARY OF HISTORIC MINE WATER DISCHARGE QUALITY

And Comparison to Alluvial Background Water Quality

Contaminant	1981 Mine Water Discharge Ambrosia Lake Area	1981 Mine Water Discharge San Mateo Area	1978-80 San Mateo Creek Upland Alluvial GW (Background)
Gross Alpha (pCi/L)	580	1,100	2.5 – 15.0
Uranium (mg/L)	2.4	0.080	0.005 – 0.010
Selenium (mg/L)	0.410	0.040	0.005 – 0.005
Molybdenum (mg/L)	0.79	0.32	0.005 – 0.010
Chloride (mg/L)	90	10	3 – 8
Sulfate (mg/L)	837	205	5-20
Total Dissolved Solid (ppm)	1,690	520	125 – 300

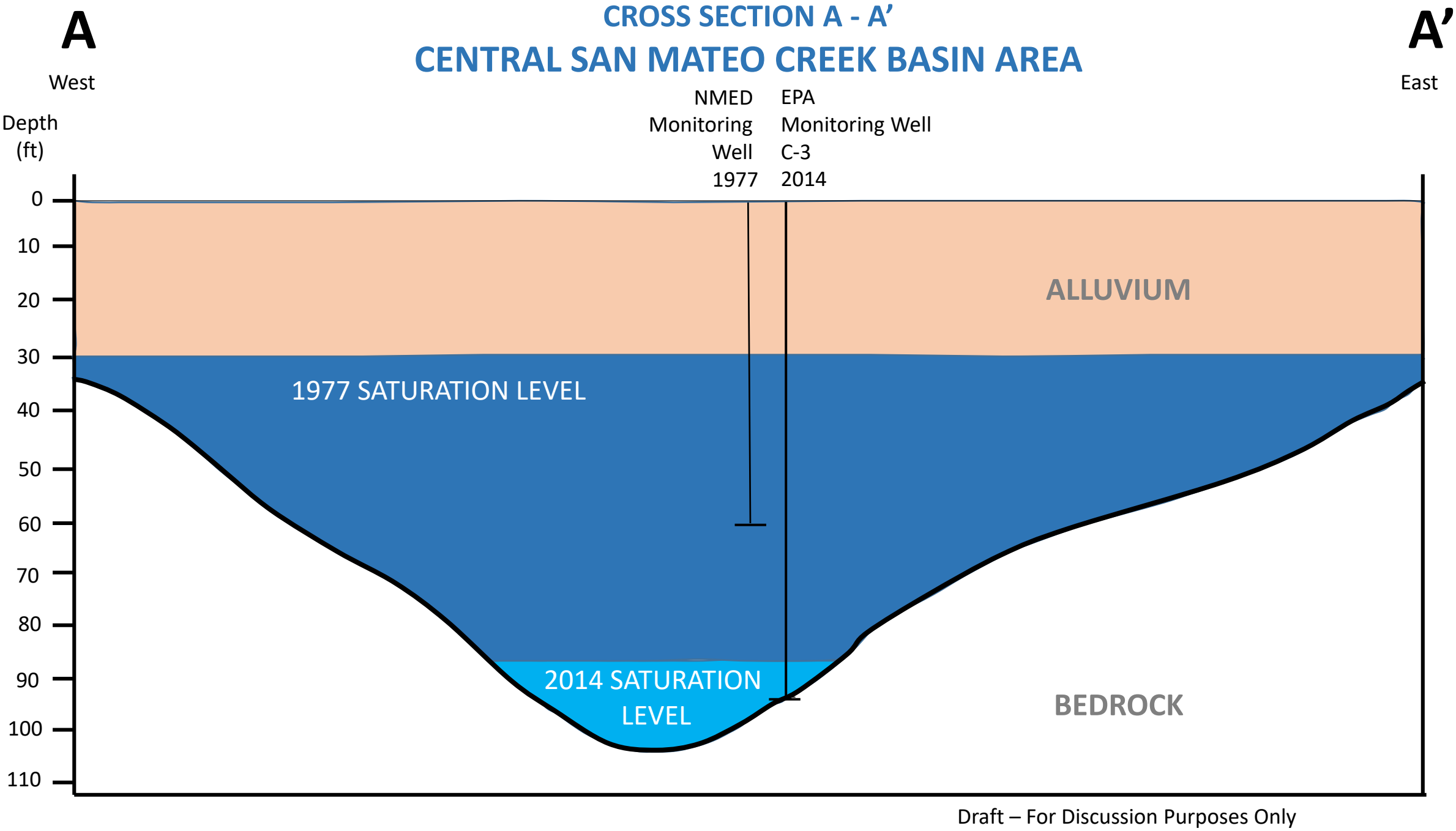
New Mexico 1981 and 1986 Reports

GROUND WATER IMPACTS



CROSS SECTION A - A'

CENTRAL SAN MATEO CREEK BASIN AREA



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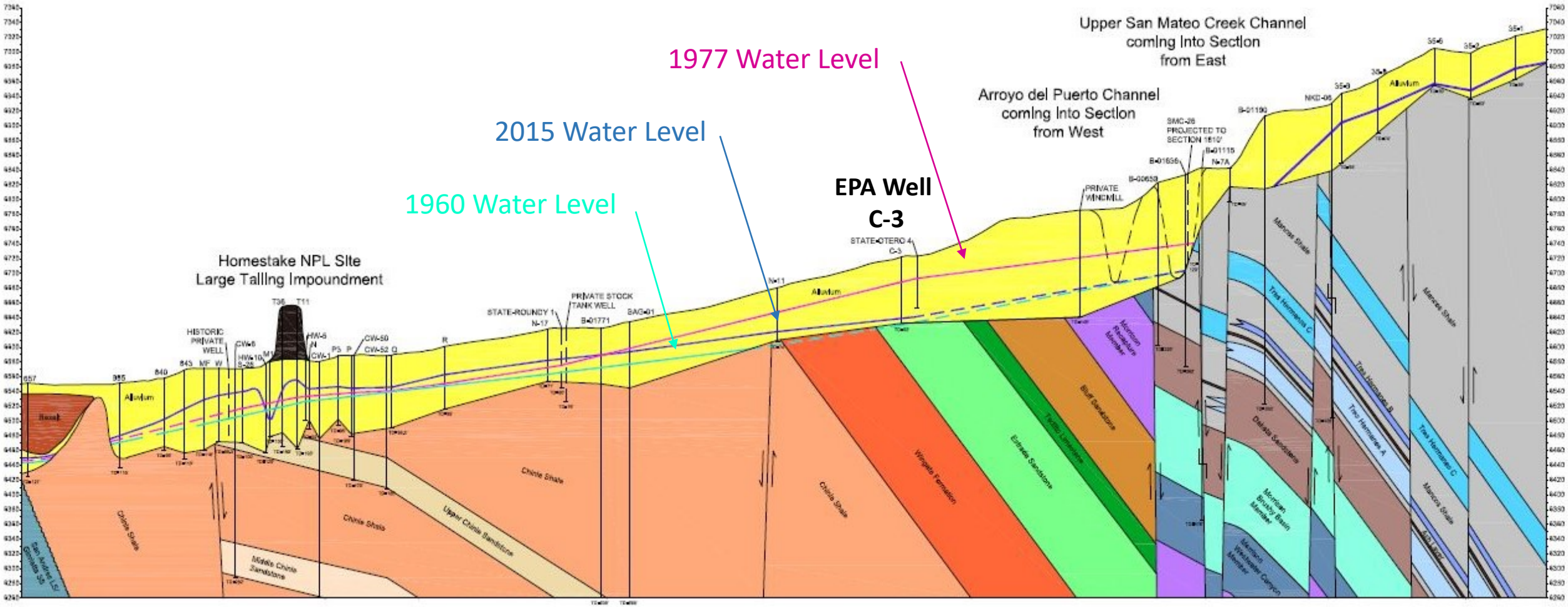
B HYDROGEOLOGIC CROSS-SECTION B’

SOUTH NOR



Vertical Exaggeration 50x

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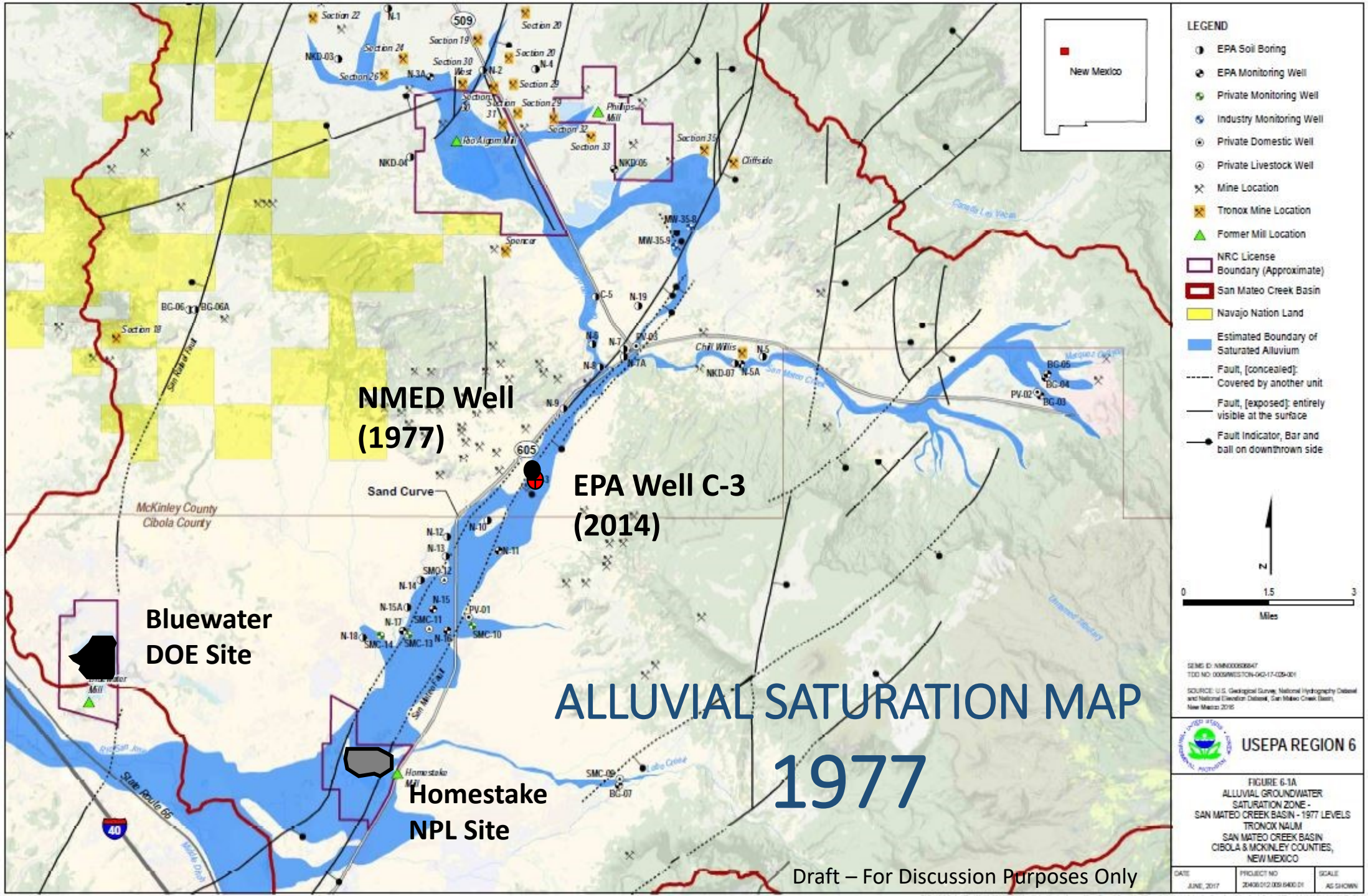
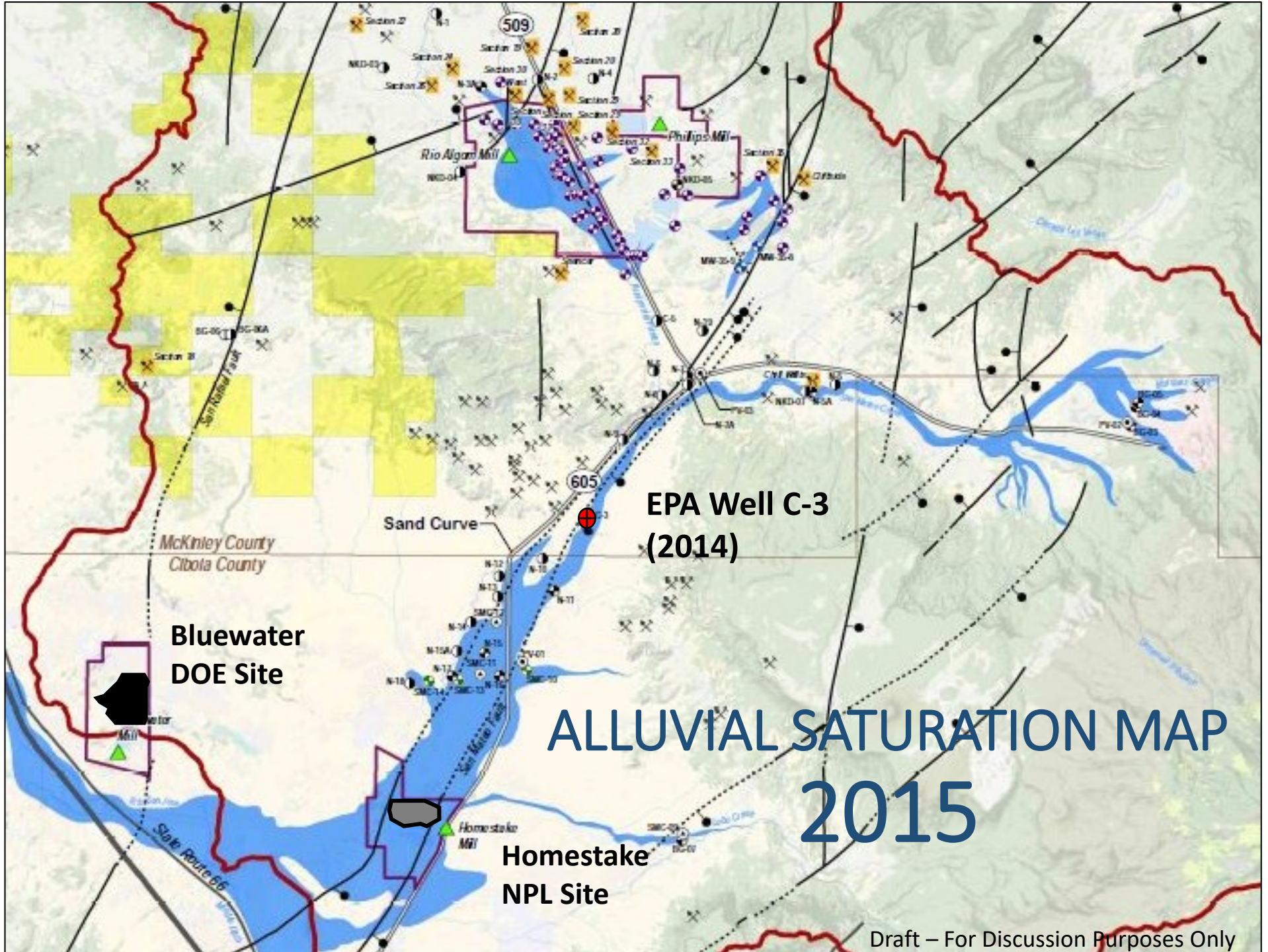
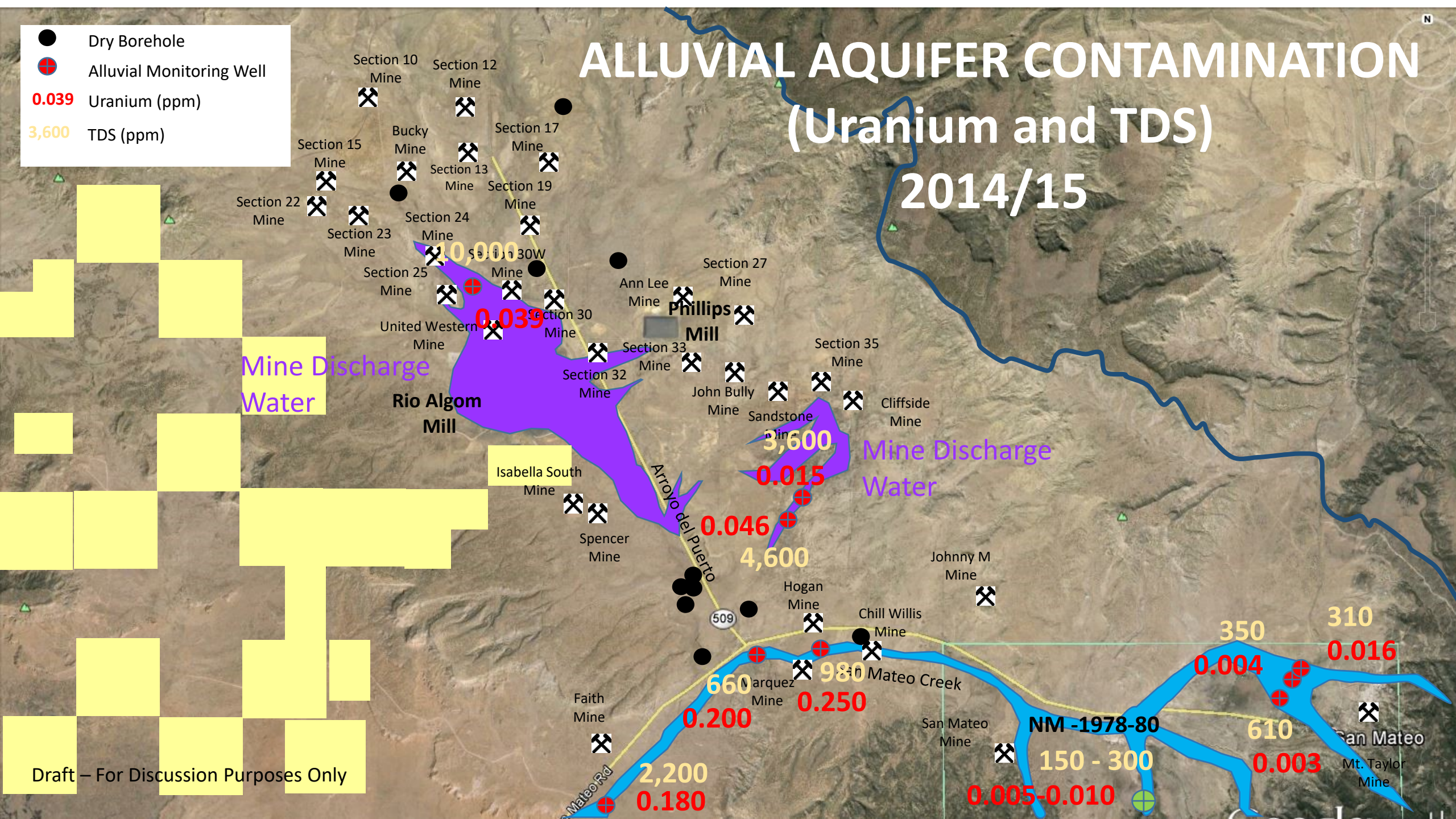

NMED Well
(1977)
EPA Well C-3
(2014)
Bluewater
DOE Site
Homestake
NPL Site
ALLUVIAL SATURATION MAP
1977
Draft – For Discussion Purposes Only
New Mexico
LEGEND
EPA Soil Boring
EPA Monitoring Well
Private Monitoring Well
Industry Monitoring Well
Private Domestic Well
Private Livestock Well
Mine Location
Tronox Mine Location
Former Mill Location
NRC License Boundary (Approximate)
San Mateo Creek Basin
Navajo Nation Land
Estimated Boundary of Saturated Alluvium
Fault, [concealed]: Covered by another unit
Fault, [exposed]: entirely visible at the surface
Fault Indicator, Bar and ball on downthrown side
N
0
1.5
3
Miles
USEPA REGION 6
FIGURE 6-1A
ALLUVIAL GROUNDWATER SATURATION ZONE -
SAN MATEO CREEK BASIN - 1977 LEVELS
TRONOX NAUM
SAN MATEO CREEK BASIN
CIBOLA & MCKINLEY COUNTIES,
NEW MEXICO
DATE
JUNE, 2017
PROJECT NO
SCALE
AS SHOWN
McKinley County
Cibola County
Sand Curve
Cliffside
Spencer
Phillips Mill
Rio Algom Mill
Chili Willis
Homestake Mill
Bluewater Mill
San Mateo Creek
San Mateo Fault
San Rafael Fault
State Route 66
509
605
40


509
605
Rio Algom Mill
Phillips Mill
Sand Curve
McKinley County
Cibola County
EPA Well C-3
(2014)
Bluewater
DOE Site
Homestake
Mill
Homestake
NPL Site
State Route 66
ALLUVIAL SATURATION MAP
2015
Draft – For Discussion Purposes Only


ALLUVIAL AQUIFER CONTAMINATION
(Uranium and TDS)
2014/15
Dry Borehole
Alluvial Monitoring Well
0.039 Uranium (ppm)
3,600 TDS (ppm)
Section 10 Mine
Section 12 Mine
Section 15 Mine
Bucky Mine
Section 17 Mine
Section 13 Mine
Section 19 Mine
Section 22 Mine
Section 24 Mine
Section 23 Mine
Section 25 Mine
Section 30W Mine
10,000
0.039
Ann Lee Mine
Section 27 Mine
Phillips Mill
United Western Mine
Section 30 Mine
Section 33 Mine
Section 35 Mine
Section 32 Mine
John Bully Mine
Sandstone Mine
Cliffside Mine
Mine Discharge Water
Rio Algom Mill
3,600
0.015
Mine Discharge Water
Isabella South Mine
Arroyo del Puerto
0.046
4,600
Spencer Mine
Johnny M Mine
Hogan Mine
509
Chill Willis Mine
350
0.004
310
0.016
660
0.200
980
0.250
Marquez Mine
San Mateo Creek
Faith Mine
San Mateo Mine
NM -1978-80
150 - 300
0.005-0.010
610
0.003
San Mateo
Mt. Taylor Mine
2,200
0.180
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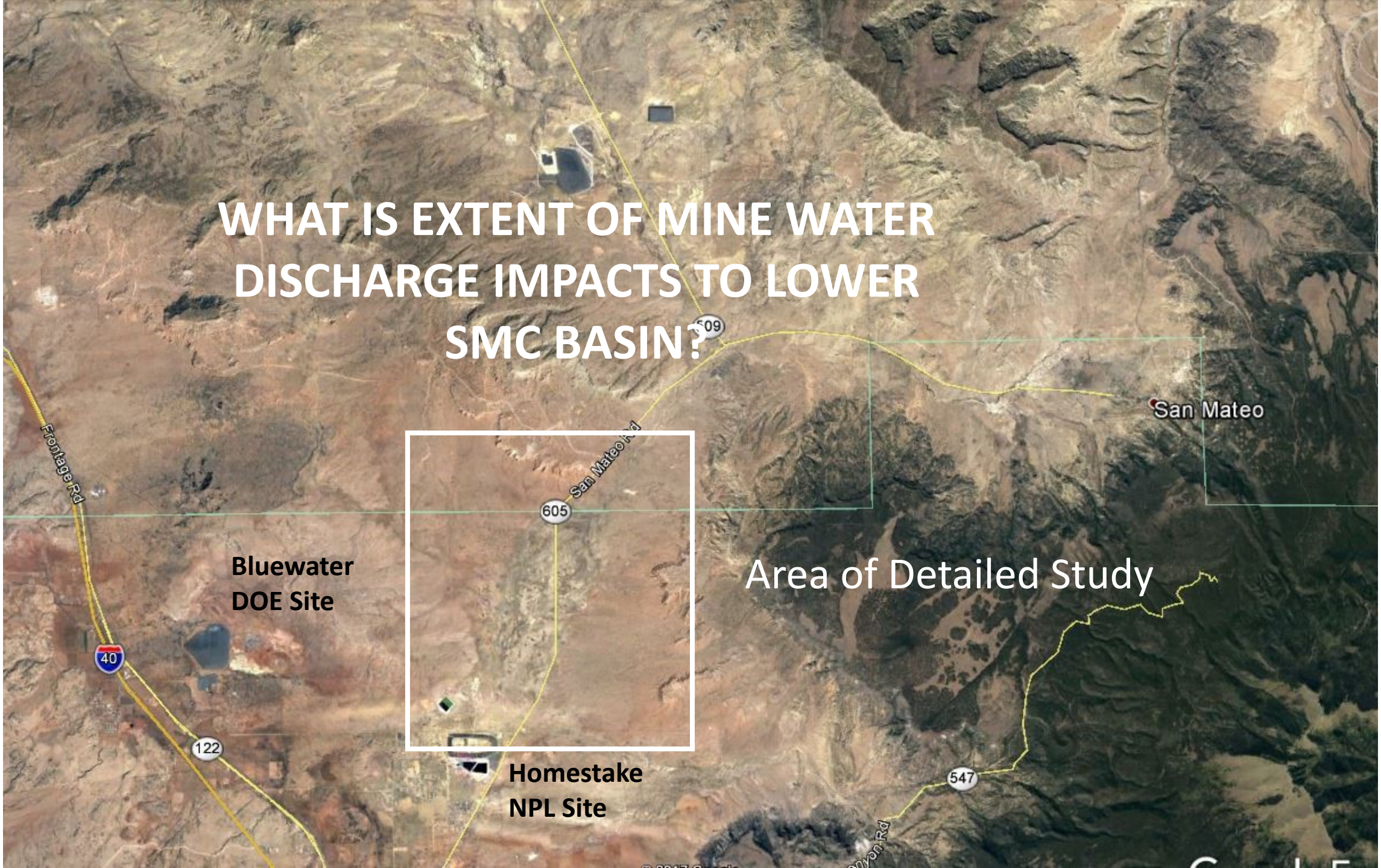
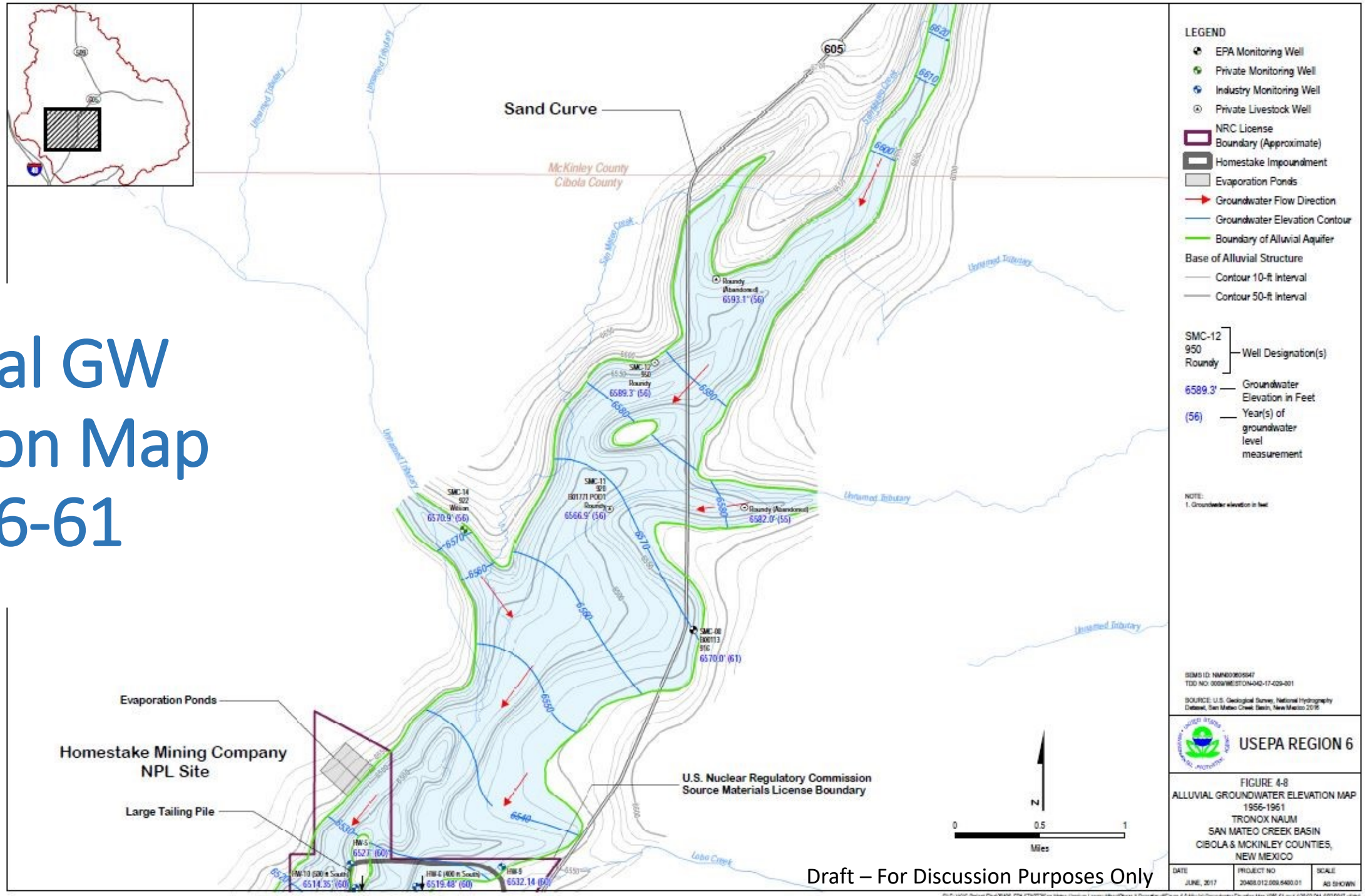

WHAT IS EXTENT OF MINE WATER DISCHARGE IMPACTS TO LOWER SMC BASIN?
San Mateo
Frontage Rd
San Mateo Rd
605
509
40
122
547
Bluewater
DOE Site
Area of Detailed Study
Homestake
NPL Site

Alluvial GW Elevation Map 1956-61



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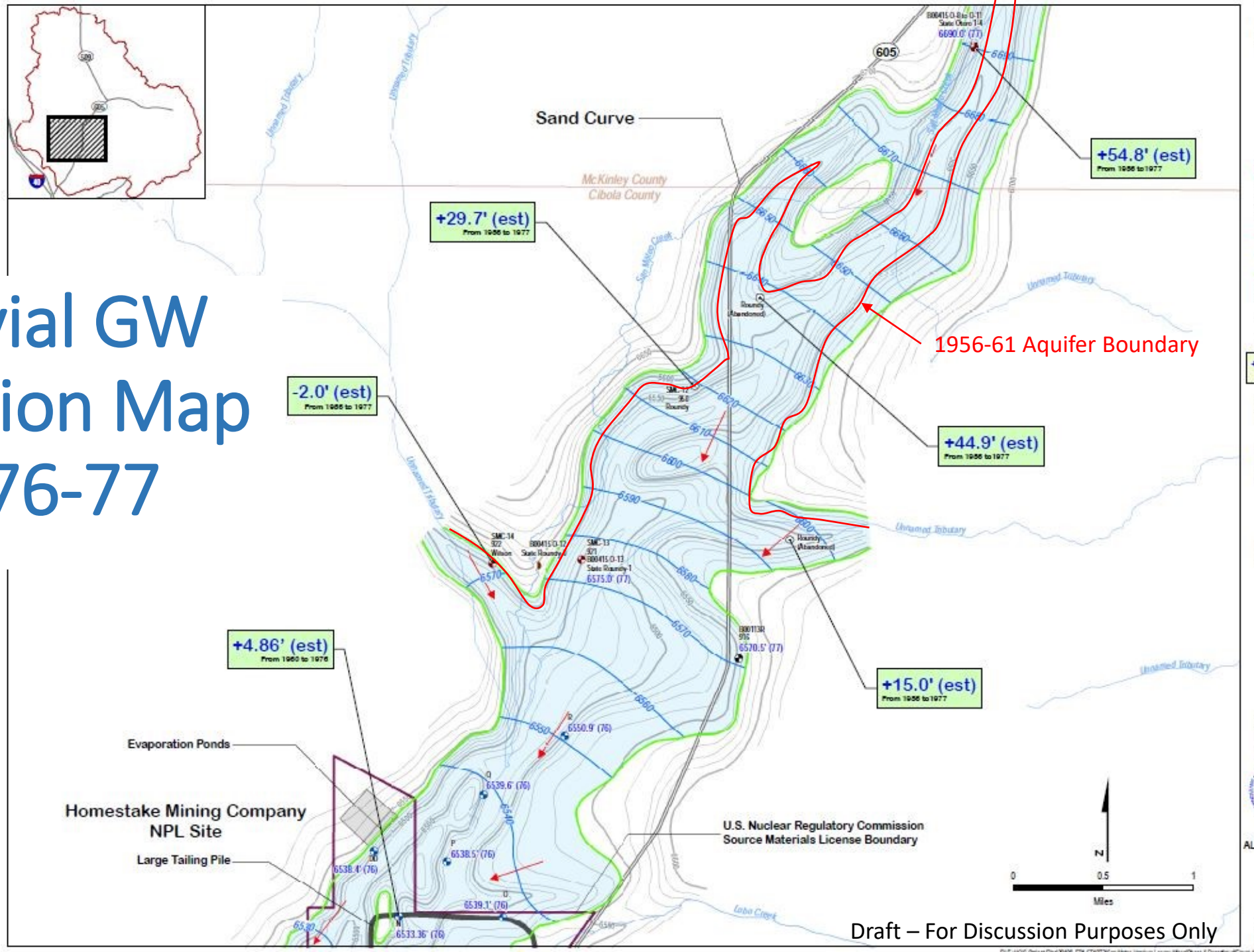
Alluvial GW Elevation Map 1976-77



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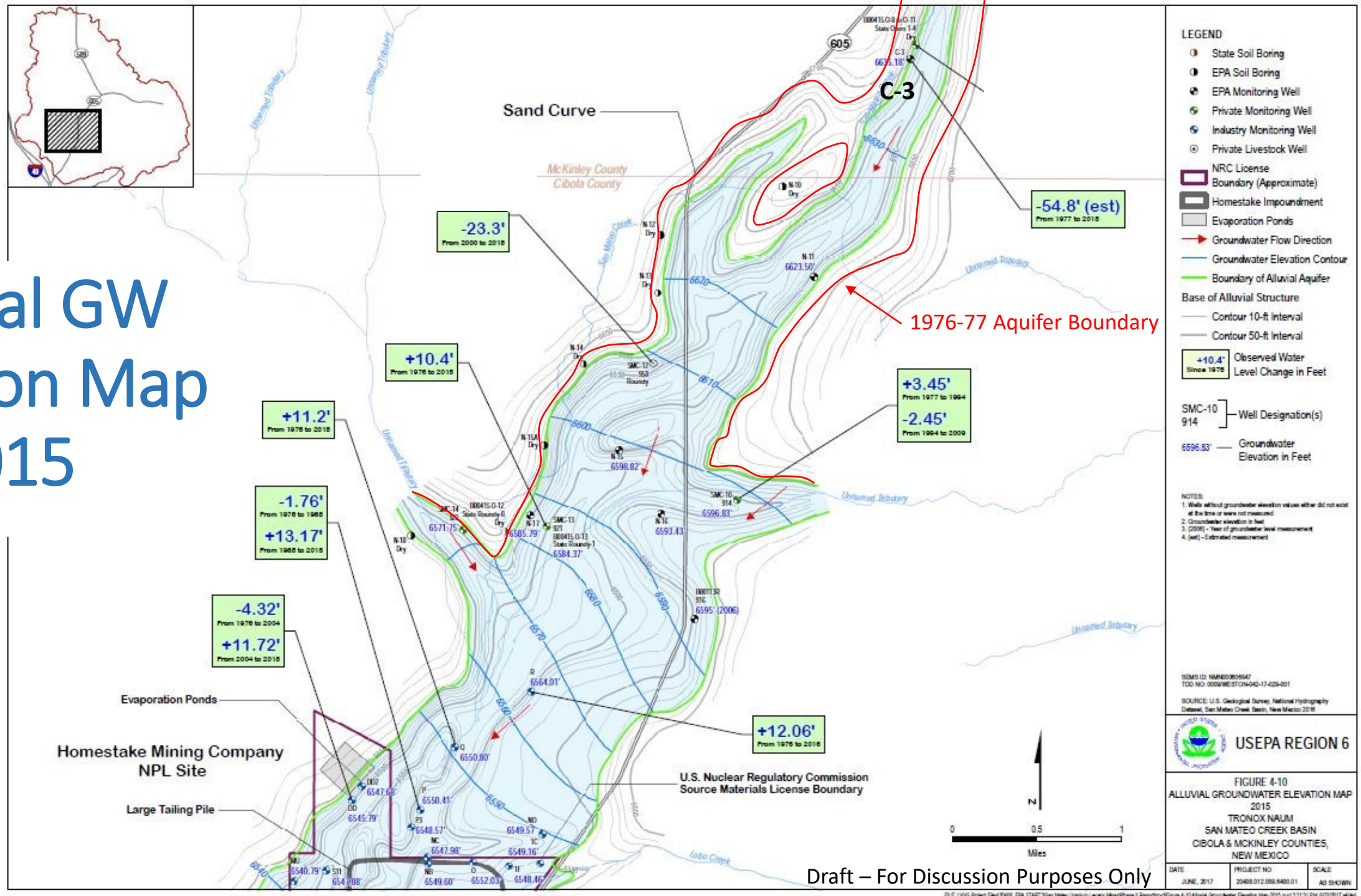
Alluvial GW Elevation Map 2015



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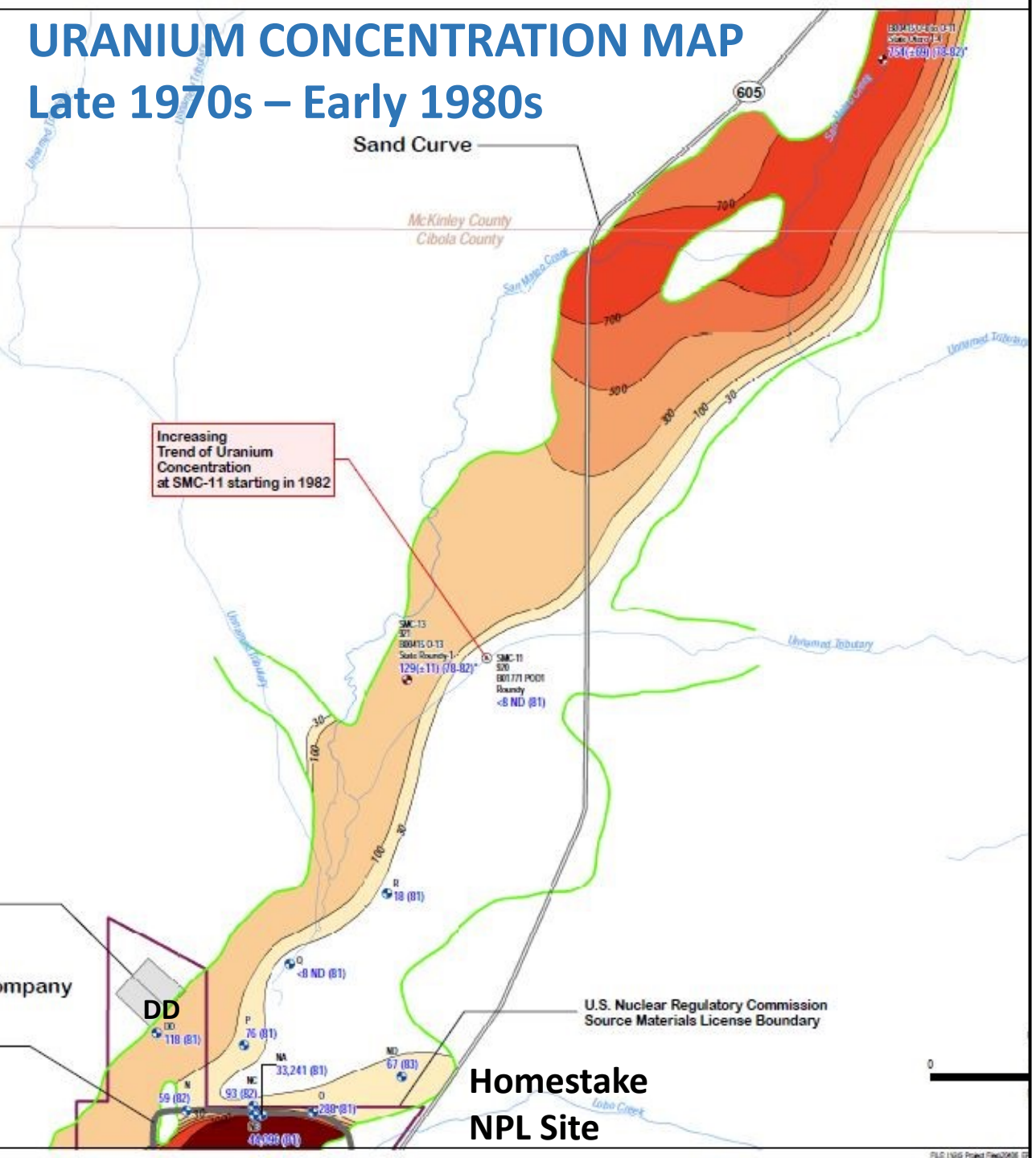
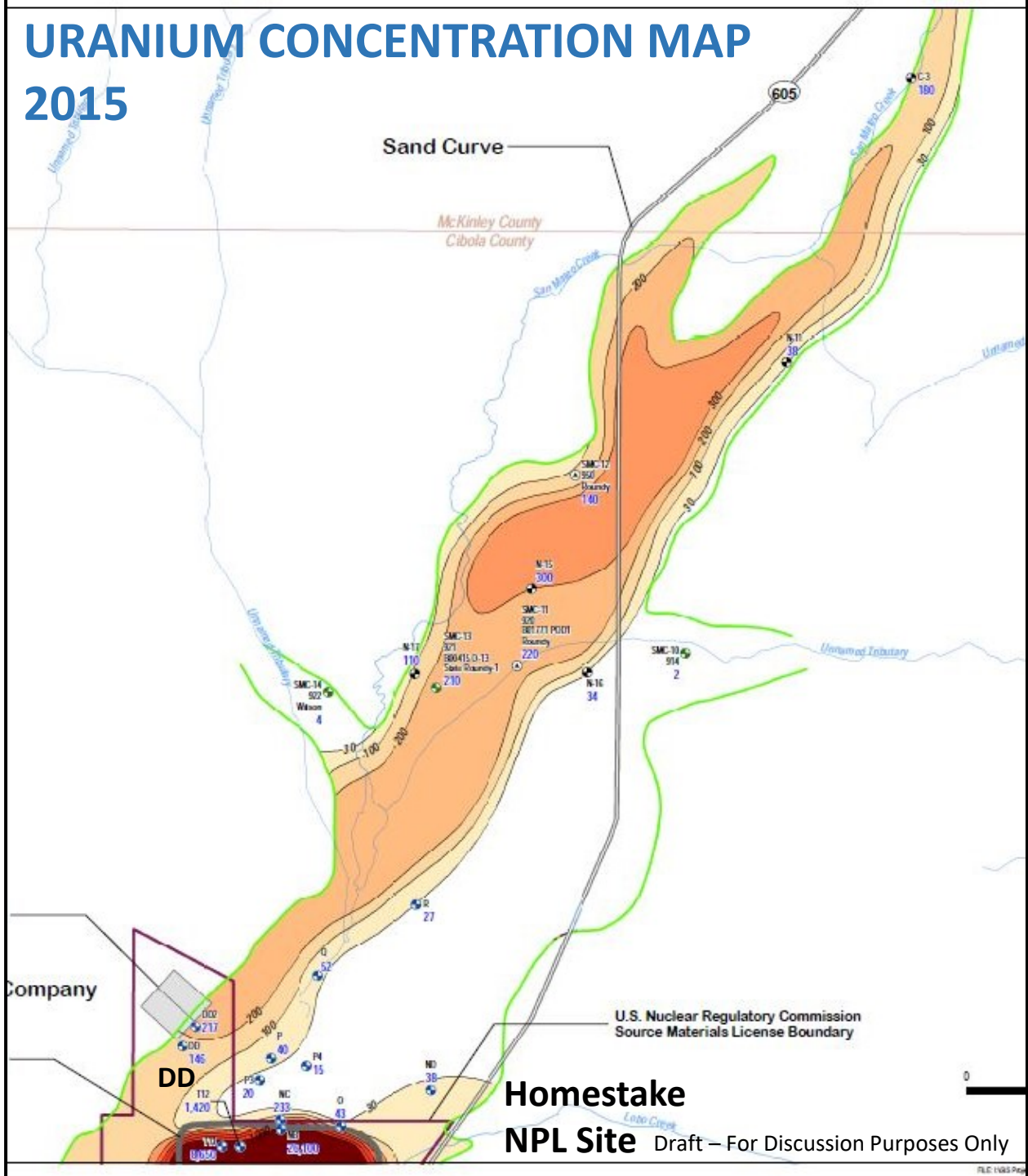
URANIUM CONCENTRATION MAP
Late 1970s – Early 1980s



URANIUM CONCENTRATION MAP
2015



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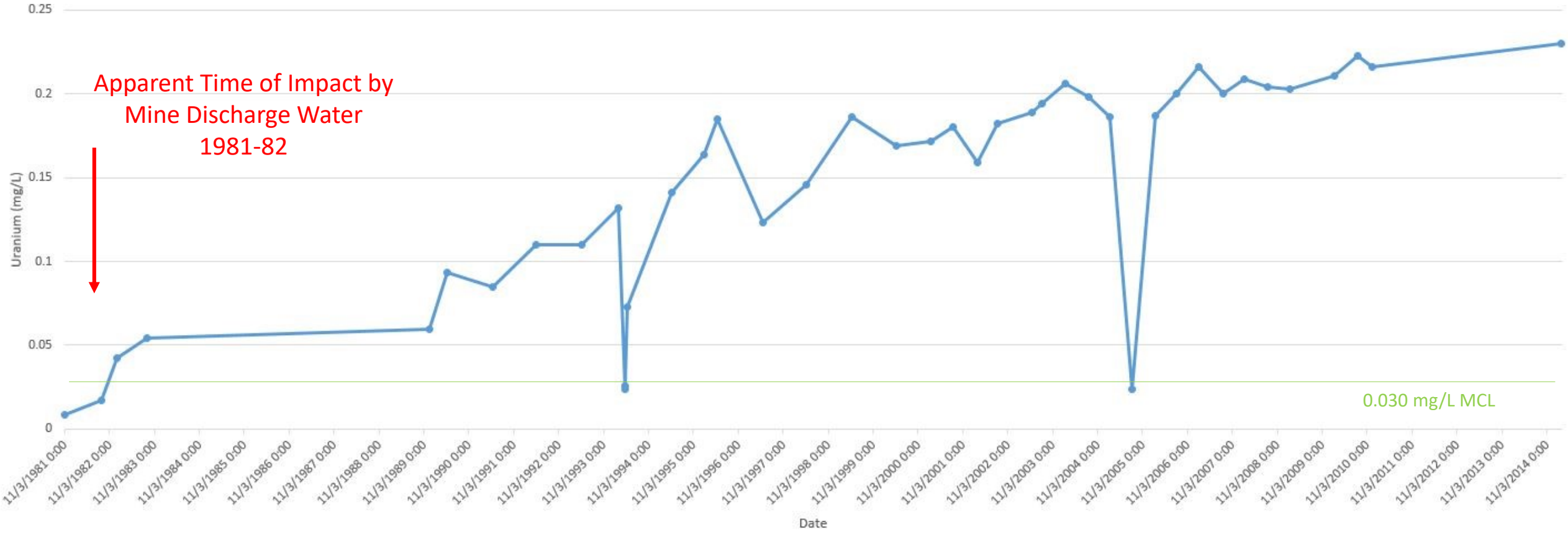
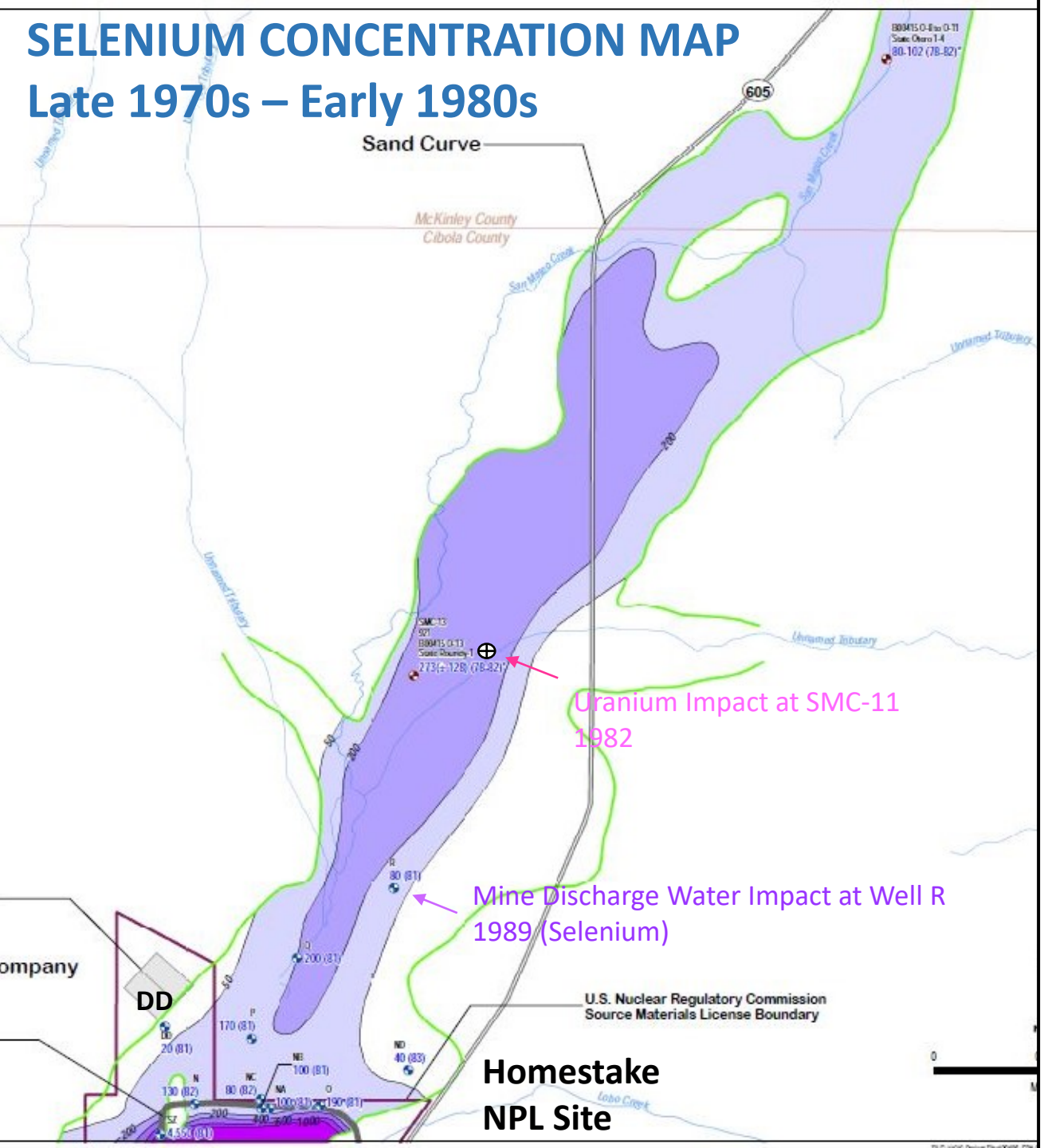
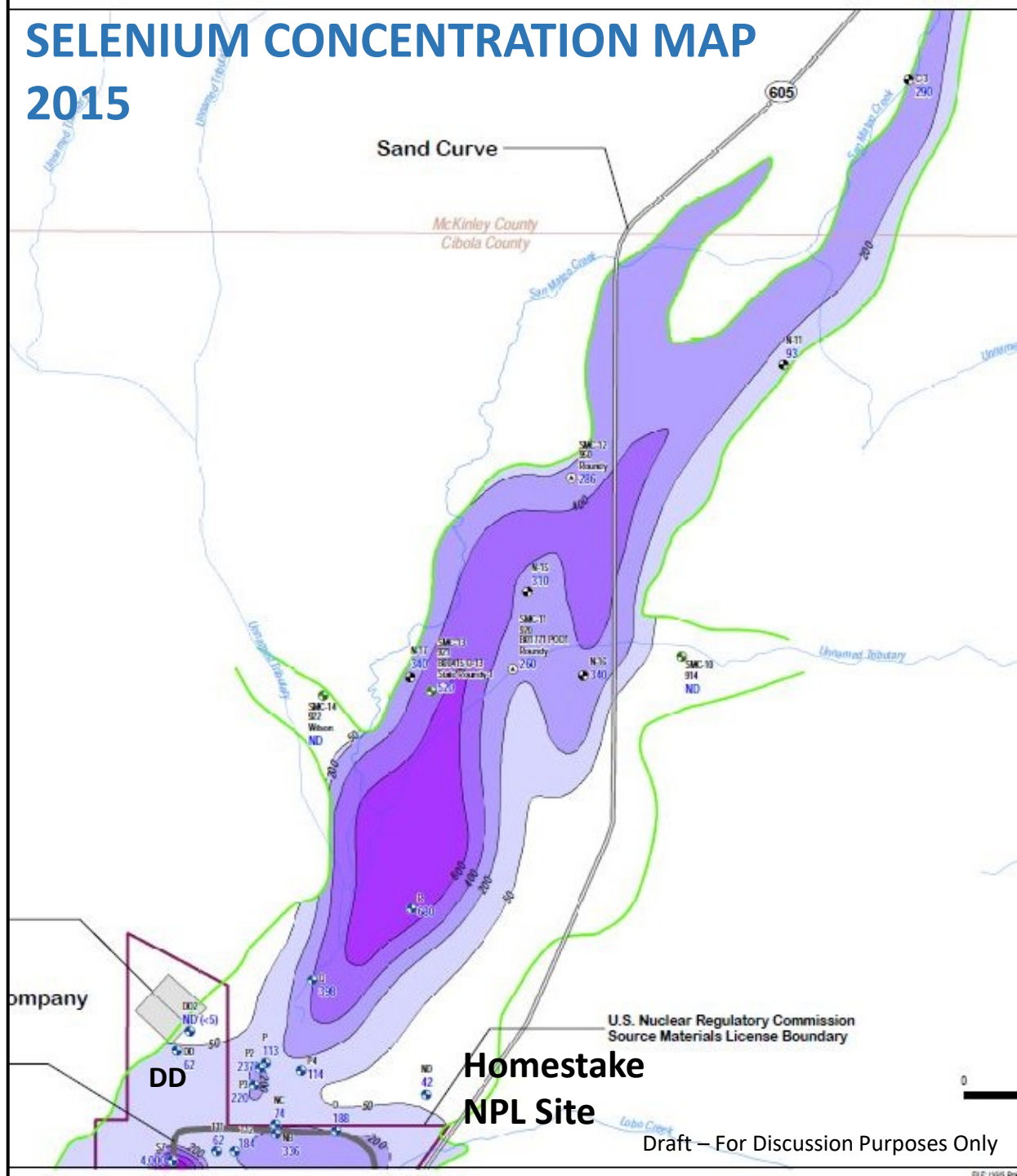
Homestake Well 920 (SMC-11)
Uranium-Time Trend Plot



SELENIUM CONCENTRATION MAP
Late 1970s – Early 1980s



SELENIUM CONCENTRATION MAP
2015



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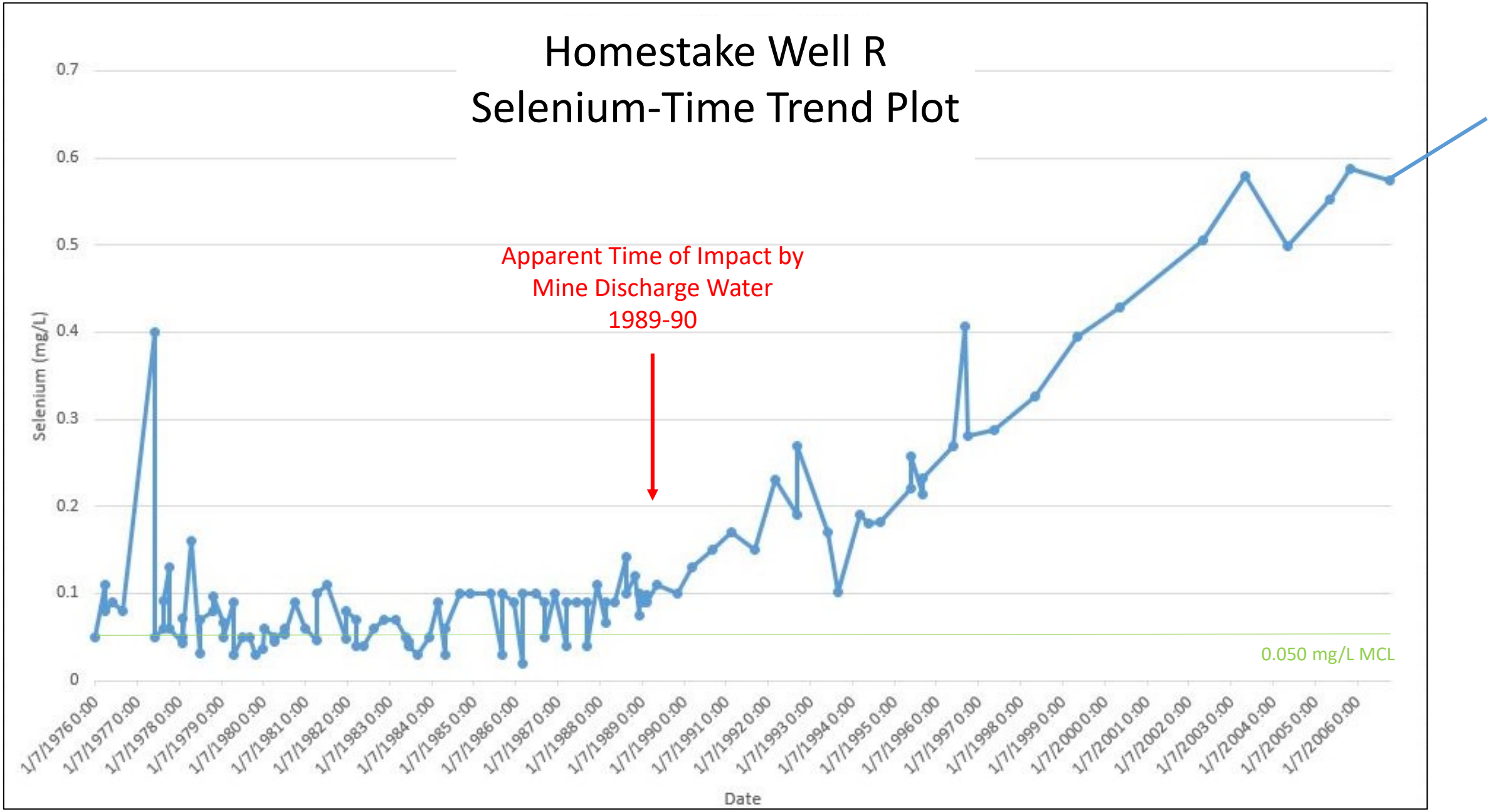
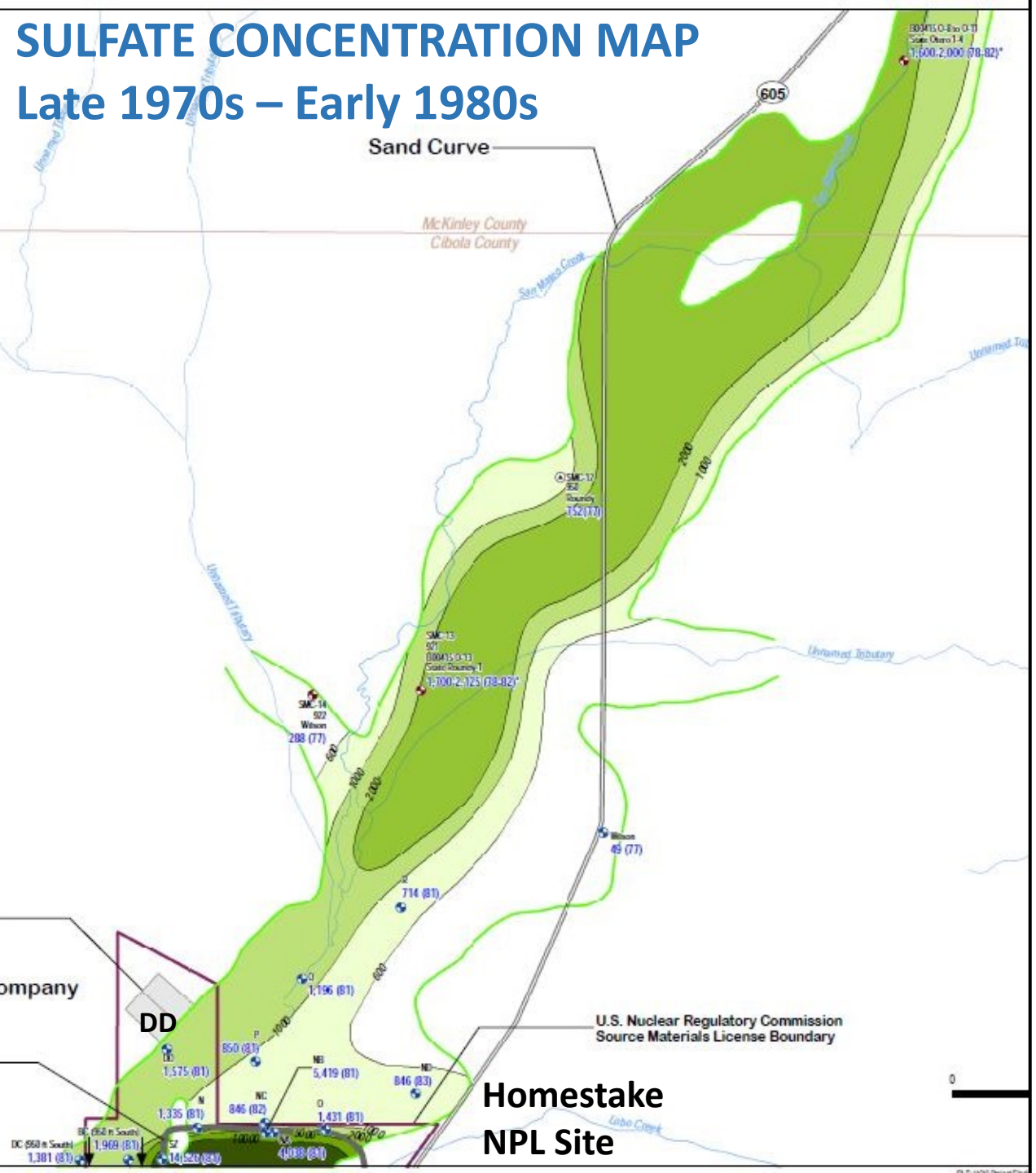
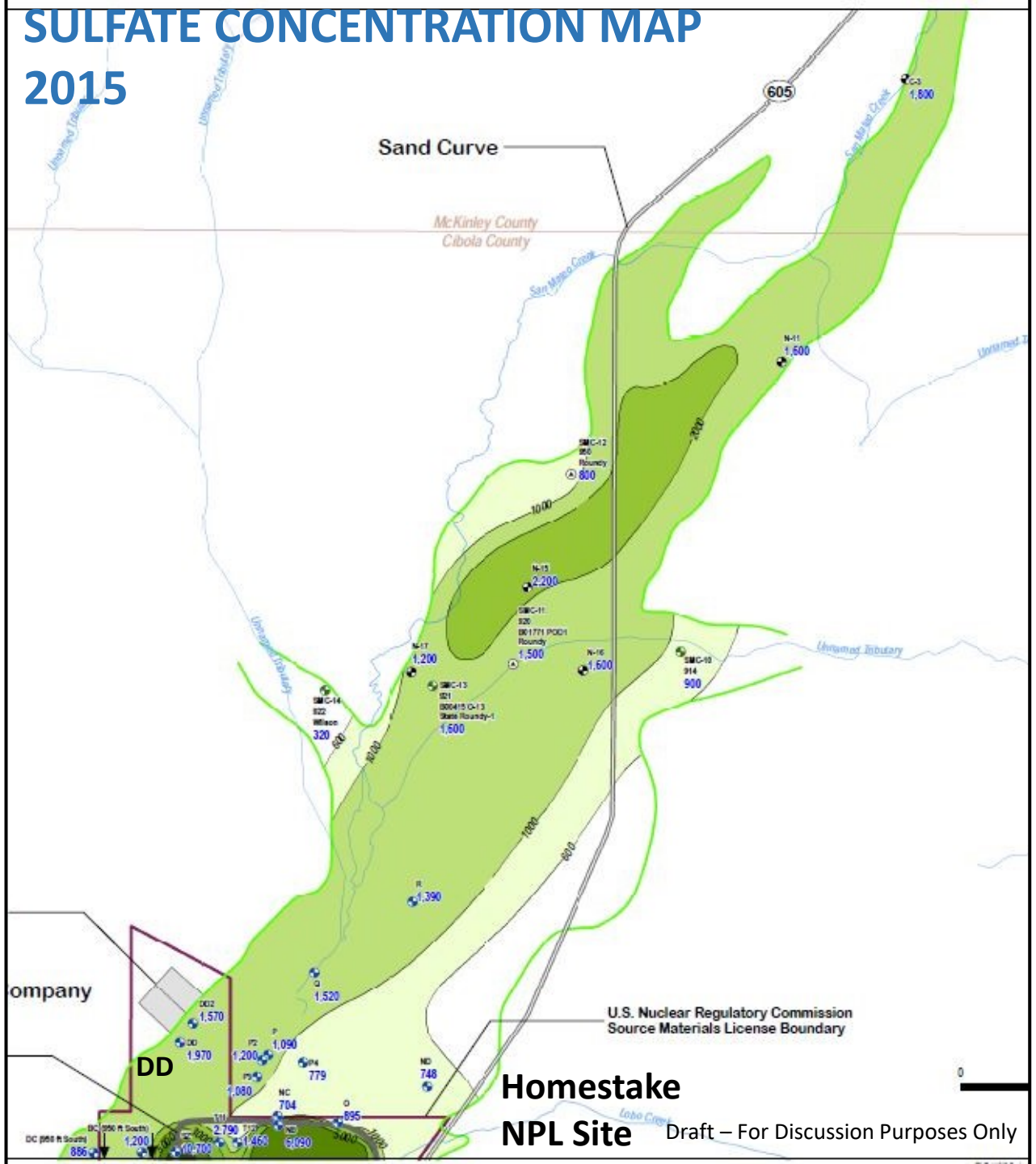
Homestake Well R
Selenium-Time Trend Plot



SULFATE CONCENTRATION MAP
Late 1970s – Early 1980s



SULFATE CONCENTRATION MAP
2015



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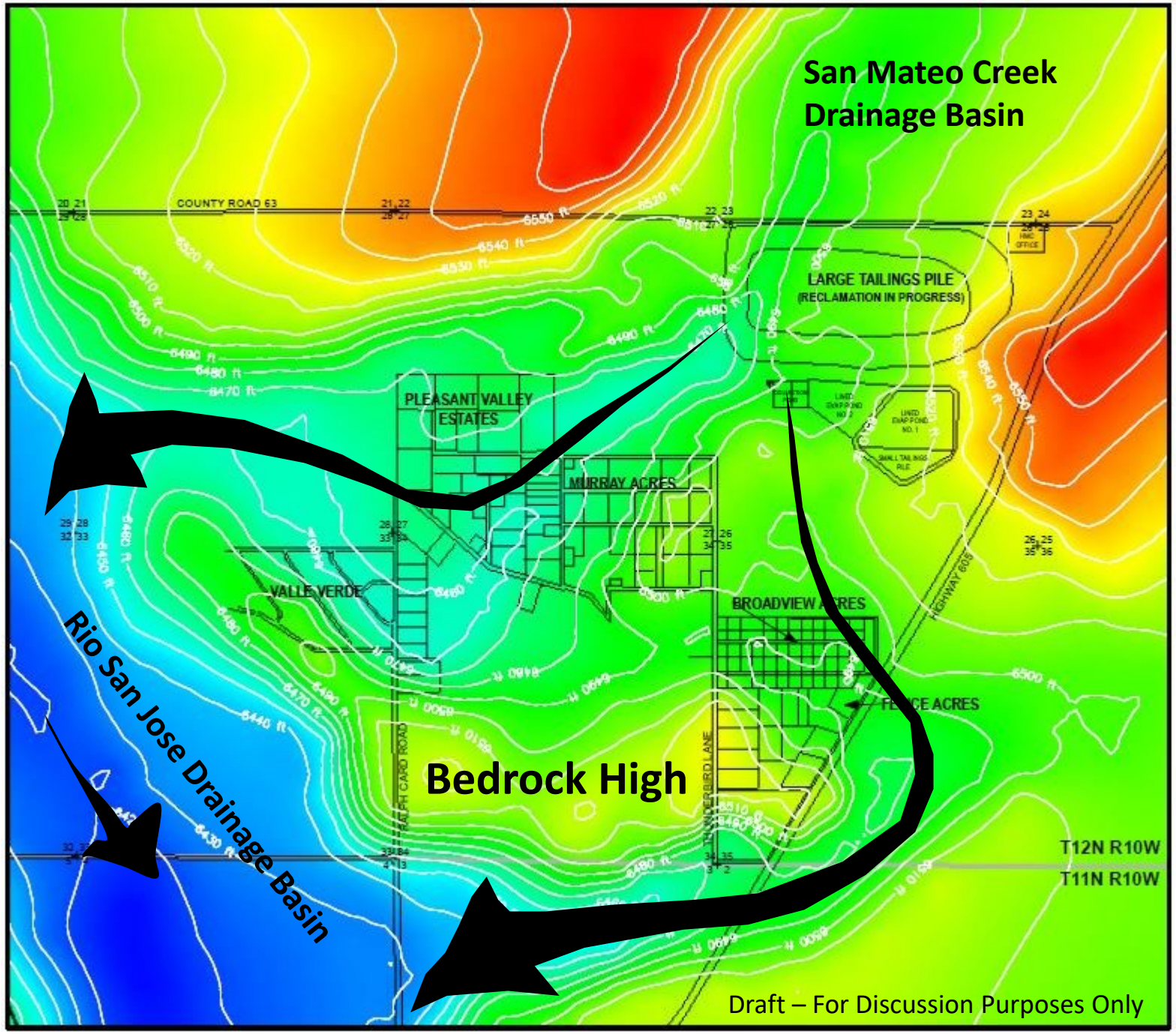
HOMESTAKE SITE BASE OF ALLUVIUM MAP

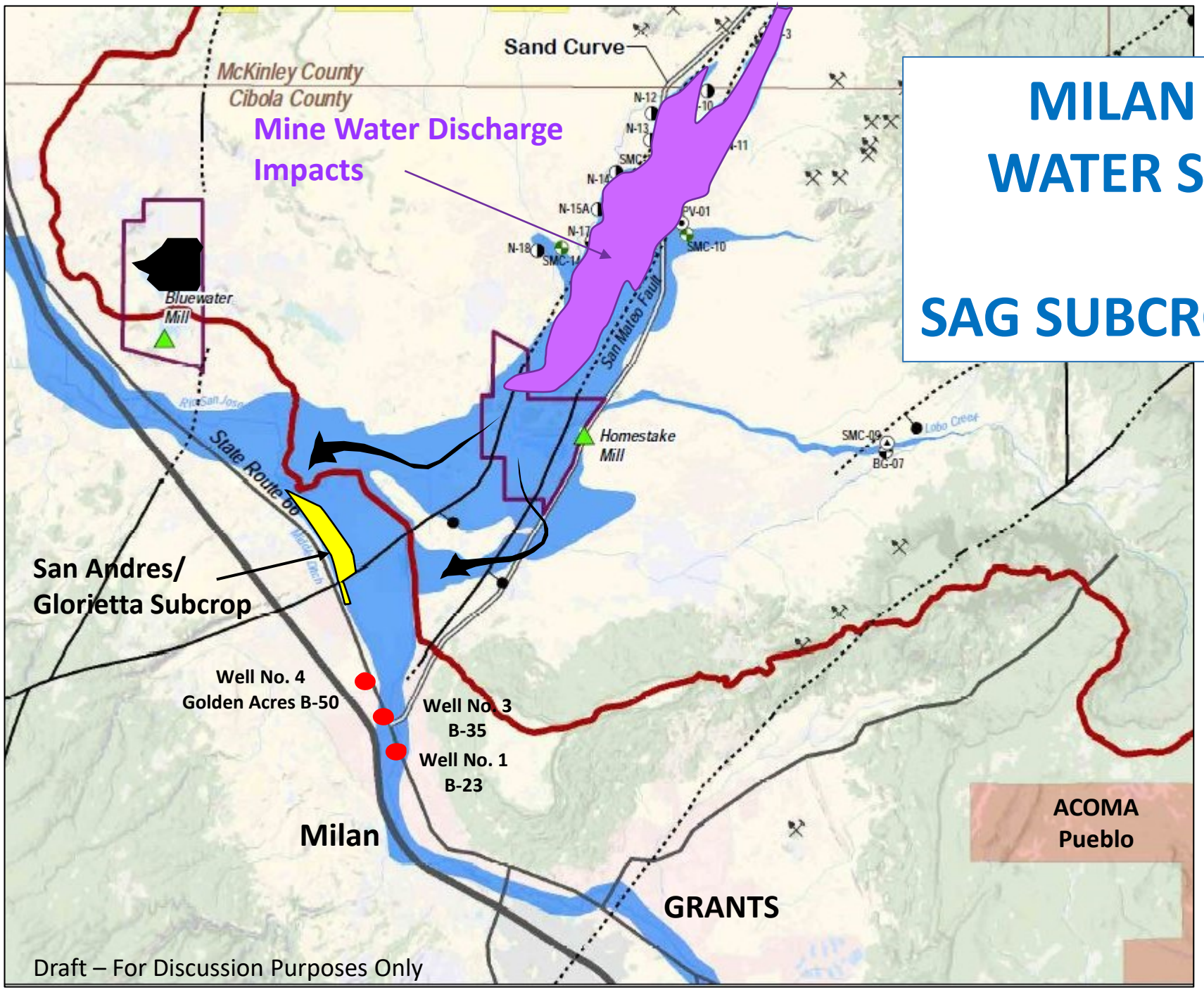


Base of Alluvium Elevation (FT-AMSL)

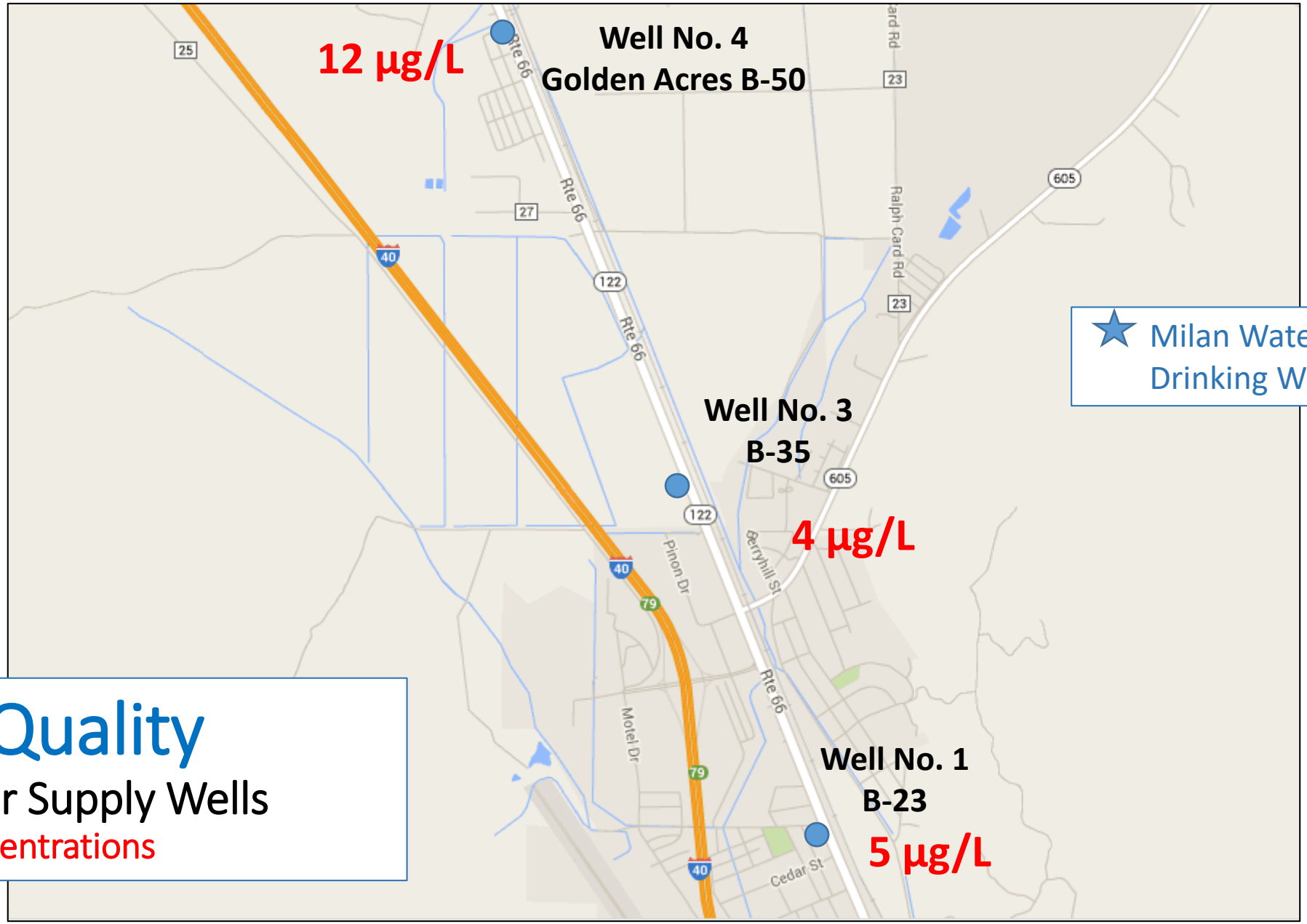
6,570
6,550
6,530
6,510
6,490
6,470
6,450
6,430
6,410

Modified from
Homestake Mining Company
Draft Correction Action Plan

MILAN MUNICIPAL WATER SUPPLY WELLS and SAG SUBCROP TO ALLUIUM



● Milan Water Supply Well



★ Milan Water Meets Drinking Water Standards

Water Quality

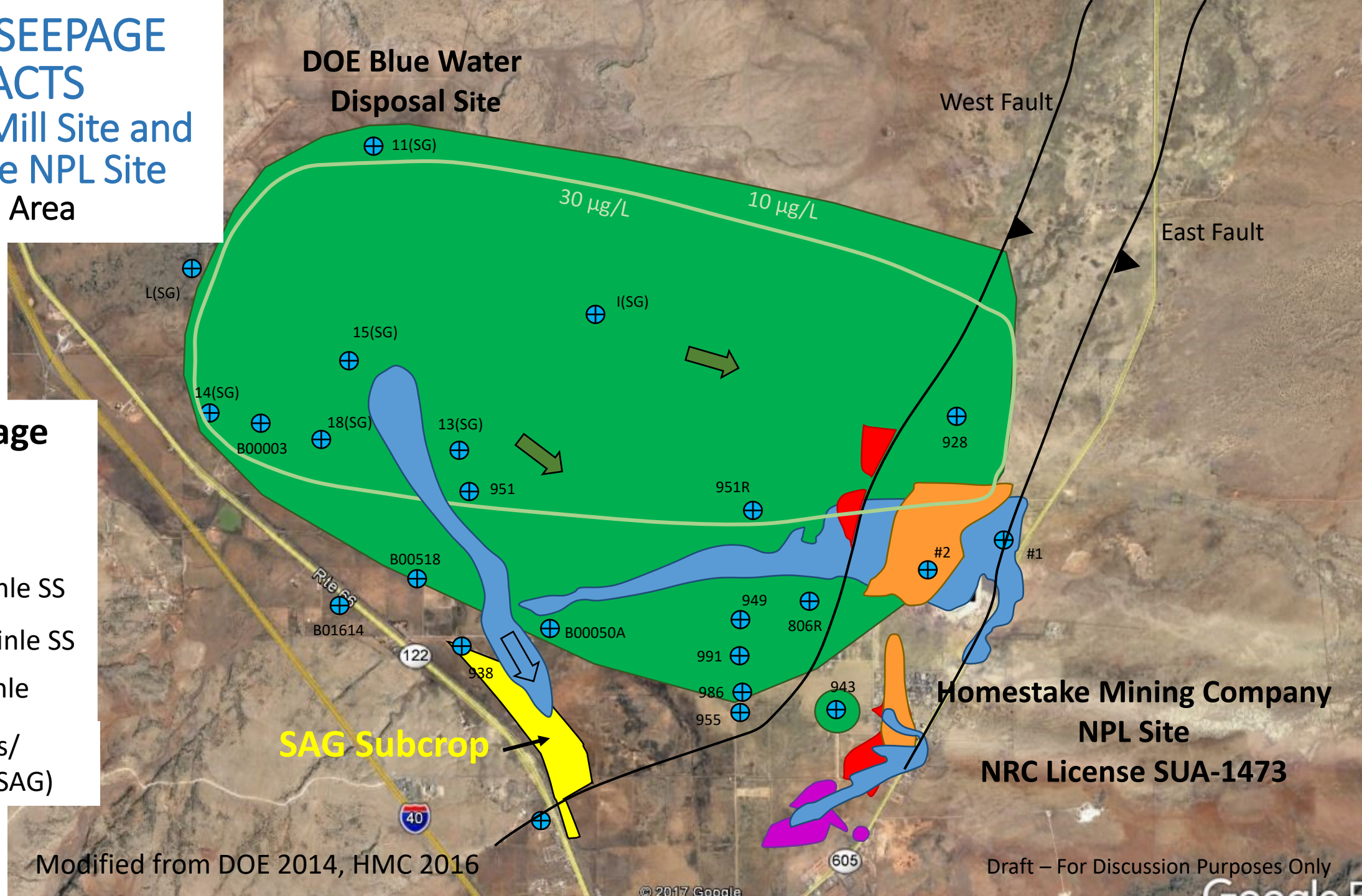
Milan Water Supply Wells

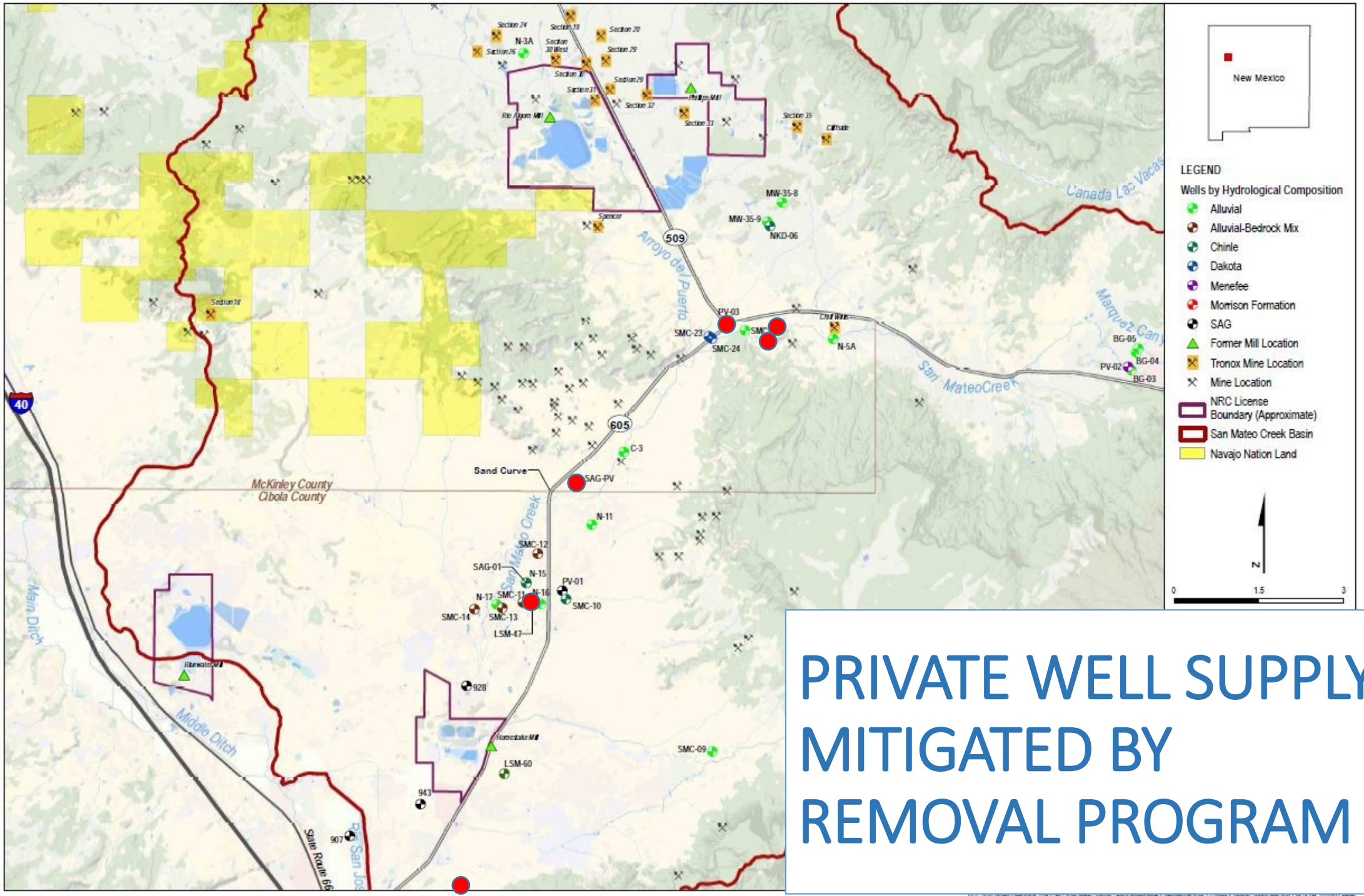
Uranium Concentrations

TAILING SEEPAGE IMPACTS

Bluewater Mill Site and Homestake NPL Site

Milan Area



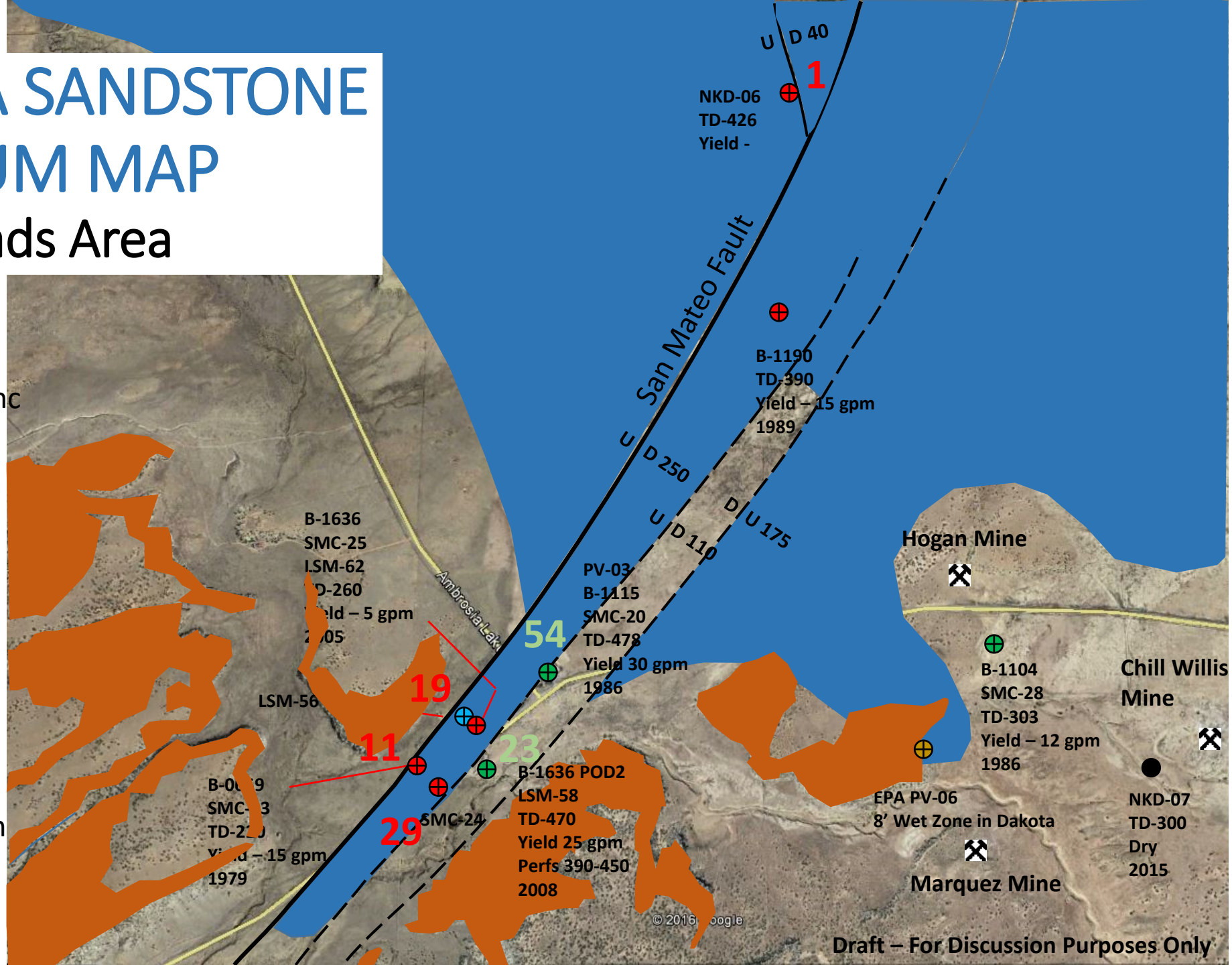


PRIVATE WELL SUPPLY MITIGATED BY REMOVAL PROGRAM

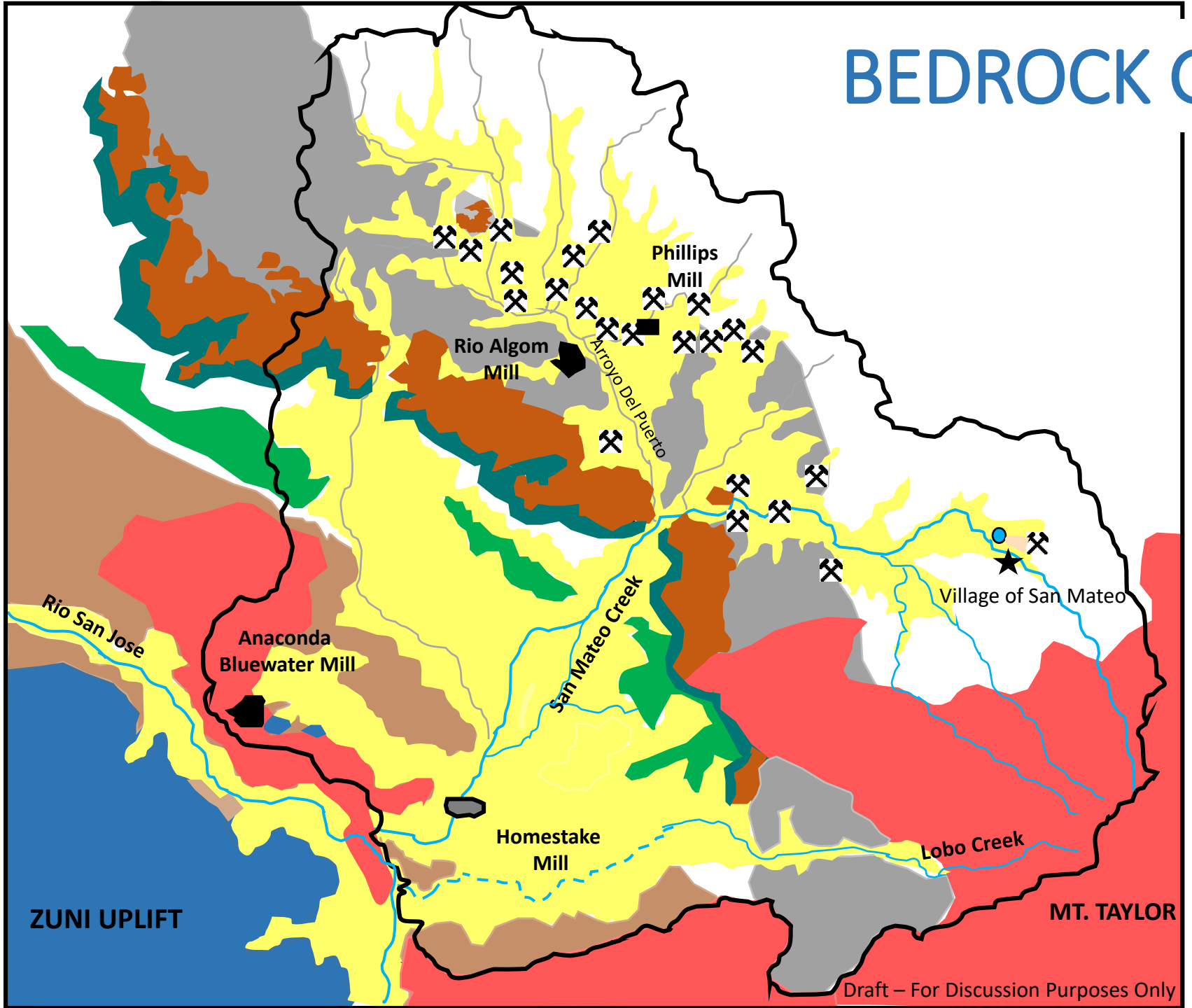
OTHER SLIDES

DAKOTA SANDSTONE URANIUM MAP

Cross-Roads Area



BEDROCK GEOLOGY



- Alluvium
- Mancos Shale
- Dakota Sandstone
- Morrison Fm
- Todilto Limestone
- Chinle Shale and Sandstone
- San Andres/Glorietta Limestone
- Volcanic
- Former Uranium Mill
- Wet Mine